Annexes

Annex 1.1 State reports .... 1.1-1 –
Annex 1.2 Meeting with stakeholders 1.2-1
Annex 2.1 Incremental costs and CO_2 abatement costs 2.1-1
Annex 3.1 Budget estimates......................... .... 3.1-1
Annex 3.2 Letter of interests from financial institutions 3.2-1
Annex 4.1 Logical framework analysis 4.1-1
Annex 4.2 Profile of project proponent 4.2-1
Annex 4.3 Work plan ....

MoEF
MoI
MoP
MOU
NGO
NPC
PCS
PD
PIR
PMC
PMO
PSCST
R&D
SDC
SIDBI
SPCB
TNA
TBU
TERI
ToR
ToT
VSBK
Zone 1

Zone 2

- Ministry of Environment and Forests
- Ministry of Industry
- Ministry of Power
- Memorandum of Understanding
- Non Governmental Organizations
- National Productivity Council
- Pollution Control System
- Project Director
- Project Implementation Review
- Project Monitoring Cell
- Project Management Office
- Punjab State Council for Science and Technology
- Research and development
- Swiss Agency for Development and Cooperation
- Small Industries Development Bank of India
- State Pollution Control Board
- Technology Need Assessment
- Technology Backup Units
- Tata Energy Research Institute
- Terms of Reference
- Training of Trainers
- Vertical Shaft Brick Kiln
- Indo-Gangetic Plains, covering North and North-East regions of India
- Peninsular India, covering Western, South Central and Southern regions of India

Brief description

Indian brick industry manufactures about 140 billion bricks annually. It uses about 24 million tonnes of coal and 2.6 million tonnes of biomass fuels. Brick production in India is generally concentrated in small brick making unit with the number of operating units about 100,000. There is technology stagnation in the traditional Indian brick industry which offers enormous potential for improving its performance levels.

The goal of the project is to help removing the barriers existing in the Indian brick industry. This will help the brick sector to adopt energy efficient and environmentally sound technological options for brick manufacturing (Operational Program–5). This will be accomplished through capacity-building, technology demonstration and promotion. Capacity building is addressed through awareness generation and imparting training at various levels to upgrade skills of brick manufacturers and their workmen.

The training programme component intends to impart training to a total of 2500 brick manufacturers and workmen during the project. Infrastructure and manpower requirements for fulfilling training needs will be developed during the project. Technology promotion is addressed through a number of demonstration projects relevant to the needs of the different regions of the country. It has been proposed that the project will cover four different technological options through 20 demonstration projects.

The financing barrier existing in Indian brick sector will also be addressed in the project. A select number of leading financial institutions/banks will be involved to provide loans to the brick manufacturers for the demonstration projects and their replication.

The Ministry of Environment and Forests (MoEF) will be the 'Executing Agency' for the project through its Country Project Co-ordinator. The Punjab State Council for Science and Technology (PSCST), Chandigarh is the Project Proponent. A Project Management Office (PMO) established in PSCST will carry out both training and technology demonstration through the Technology Backup Unit (TBU) and Project Monitoring Cell (PMC). The Steering Committee and the Executive Committee formed under the project will provide recommendations necessary for guiding the course of the project.

A participatory approach will be followed to ensure the self-sustainability of the activities beyond the project duration. Improved awareness, trained manpower together with the availability of off-the-shelf technologies from technology providers and credit facilities through financial institutions/banks will help in adoption and sustainability of energy efficiency in the Indian brick sector. A revolving fund mechanism has been suggested which will also help in the sustainability of the programme beyond project duration.

The total budget estimates for the project is US$ 6,038,900. It has been proposed that brick manufacturers will contribute US$ 969,140 (16% of total budget) towards technology demonstration and capacity building component. The cost towards land requirements for technology demonstration is excluded from the project as the cost will be site-specific and the same will be borne by the beneficiaries. The GEF will provide rest of the finance requirements i.e. US$ 5,069,760 (84% of the total budget estimates).

1

Detailed project description

1.1 Background

The Indian brick industry is the largest brick producer of bricks in the world after China. Brick production for the year 2000-01 is estimated at about 140 billion bricks. The Indian brick industry is unorganised with small production units clustered in rural and peri–urban areas. As per the survey carried out, there are about 100,000 brick kilns operating in the country. More details about the Indian brick industry are given in **annex 1.1.**

Brick-making is an energy-intensive process and consumes about 24 million tonnes of coal and 2.6 million tonnes of biomass per year. Coal consumption by the brick industry is approximately 10% of the total coal consumption in the country. The share of energy in total production costs is 35 to 45%. It has been estimated that the Indian brick industry every year spends more than one billion dollars on fuel. The large production of fired bricks has an impact on the environment in the form of CO_2 emissions, air pollution, topsoil erosion, deforestation etc. In this context, it becomes important to develop and demonstrate efficient kilns for firing bricks to conserve fuel and reduce environmental pollution.

Several types of brick kilns are used for firing bricks. The choice of technology depends generally on factors such as scale of production, soil and fuel availability, market conditions and skills available. The brick-producing regions can be categorized into two major zones based on nature of soil availability:

- Indo-Gangetic Plains, consisting of the north and north east part of India. Good quality of alluvial soil is available for brick making in this region and it caters to about 65% of the total demand (Zone–1)

- Peninsular India, consisting of the south central and southern parts of India and meets balance 35% of total demand (Zone–2). This region has shortage of good quality soil for brick making.

The brick kilns operating in India can be classified into two groups namely, (1) intermittent kilns and (2) continuous kilns. Intermittent kilns, commonly called clamps, are generally used when the volume of production is small. The production capacity of intermittent kilns ranges from 5,000 to 2,00,000 bricks per firing. A variety of fuels such as coal, firewood, various types of agricultural residues, dungcakes etc. are used in clamps. The arrangement of bricks in a clamp generally depends on the type of fuel. Intermittent kilns have low energy efficiencies as most of the heat in the flue gases, fired bricks and kiln structure remains unutilized.

Continuous kilns are used when the volume of production is high, more than 15,000 bricks per day. These kilns are superior to intermittent kilns in terms of energy efficiency as well as the quality of bricks. Large-scale energy savings to the extent of 30 to 50% are possible by the replacement of intermittent kilns by continuous kilns. The use of intermittent kilns particularly clamps is still quite popular, mainly due to (1) the almost 'zero' cost of kiln construction, and (2) flexibility in production volume and variety of fuel.

Continuous kilns are more efficient as they have better heat recovery features. Bull's trench kiln (BTK) with moving metallic chimneys is the most popular continuous kiln in India. A more efficient version of BTK, with a fixed chimney and flue duct arrangements is fast replacing the moving chimney kilns because of environmental regulatory pressure. Other continuous kilns operating in small numbers are the Hoffmann kiln and high draught kiln.

The Indian brick industry is growing[1][1] at a rate of 4% per year. The sector provides employment[1] for about 8 to 10 million workers. The brick sector is labour-intensive although a few brick kilns are mechanised.

A number of barriers that impede its growth are lack of trained manpower, access to finance and awareness on energy and environmental issues. It is also characterised by low profile of technologies, low profit margins, high pollution and poor working conditions.

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[1][1] India Brick Project – July 2000 to June 2001 prepared by Tata Energy Research Institute and submitted to Swiss Agency for Development and Co-operation (SDC)

Due to the increasing concern about environment security in last few years, the Government of India (GOI) is framing policies for pollution abatement in all industrial sectors. The existing environmental regulations concerning the brick industry can be divided into two categories:

- Emission standards for brick kilns
- Promoting use of fly ash in building materials.

A notification on environmental norms was issued by the Ministry of Environment and Forests (MoEF), GOI, during 1996, for meeting the minimal emission standards by brick kilns **table 1.1**. The emission limits for suspended particulate matter (SPM) are achievable by changing over to fixed chimneys and installing gravity settling chamber (GSC) in BTKs. The existing moving chimney BTKs have been provided with a time limit upto June 2002 for the change over to fixed chimneys and install pollution control systems (GSC) for meeting the environmental standards. In northern India, a large number of BTKs have either been converted to the fixed chimney type or are in the process of conversion. However, the process of conversion in Southern and Western regions is quite slow probably due to the non-availability of trained manpower. There are about 50,000 brick kilns which need conversion to the fixed chimney type. Thus there is plenty of scope for improving the energy and environmental performance of brick kilns in India.

Table 1.1 Emission standards for brick kilns

Size	*Kiln capacity*	*Maximum concentration limits of SPM (mg/Nm^3)*
Small	Less than 15,000 bricks per day (less than 4 5 metre trench width)	1000
Medium	15,000 to 30,000 bricks per day (4 5 to 7 0 metre trench width)	750
Large	More than 30,000 bricks per day (More than 7 0 metre trench width)	750

Source: Ministry of Environment and Forests, Government of India

The Central Pollution Control Board (CPCB) and state pollution control boards exercise the environmental regulations whereas administrative controls in certain states lie with Food and Civil Supplies department.

Considering the immediate need to protect top soil and find methods for the safe disposal/ utilization of fly ash from coal fired power plants, the MoEF issued a notification in September 1999 saying that all brick manufacturing units situated within a radius of 50 kilometer from coal based power plants, shall utilize fly ash in optimal proportion for brick making.

Other than MoEF, local governing bodies also frame regulations time to time. In many parts of India, top soil conservation regulations have been enacted by local bodies to avoid degradation of land for orchard farming. In certain parts of country, the depth of excavation is restricted to 3 to 4 feet.

1.2 Existing institutional framework

To facilitate changeover to fixed chimney type BTKs, few institutes in the government sector are supporting brick manufacturers by offering them a suitable fixed chimney kiln design **(section 1.3.1)**. These institutes are also working on design improvements for better kiln performance.

Brick manufacturers have state-level and brick associations in each state. There are also a number of district level associations. Most of these associations are members of a national association – the All India Bricks and Tiles Manufacturers' Federation (AIBTMF). The AIBTMF takes up the concerns of brick manufacturers with government and regulatory bodies.

The Ministry of Rural Development has also set up institutions locally such as Khadi and Village Industries Commission (KVIC) to provide finance to brick manufacturers. These institutions cater to small loan requirements with a mechanism that suits the needs of small manufacturers.

1.3 Project rationale and objectives

Though the Indian brick industry is quite large and some initiatives have been undertaken to improve its performance **(section 1.3.1)**, it still uses inefficient technologies at large, in different processes of brick making. The technology has remained stagnant over the years. This has resulted in higher energy consumption and emissions particularly of the greenhouse gas (CO_2). The key barriers identified[1 2] which effect the energy consumption and emissions from brick kilns are given below:

[1 2] A meet was organised with brick manufacturers and industry associations to identify the major barriers that impede the growth of the sector (refer **annex 1.2** for details)

Lack of information

The Indian brick sector lacks information on efficient technologies and operating practices. This calls for interventions to provide such information to brick manufacturers through information dissemination and awareness generation.

Lack of availability of trained manpower

The entire brick production process in the country is dependent on traditional firemen. Thus there is a need for capacity building – to create a pool of trained manpower such as workers, supervisors and brick-kiln manufacturers. Certain level of instrumentation also needs to be introduced to monitor and control the kiln performance.

Higher perceived risks for energy-efficient technologies

The brick kiln is mostly family owned business using traditional technologies and operating practices. The brick manufacturers do not venture into new promising technology as it not only involves high initial capital costs but equally high investments are at stake in its subsequent operations. Therefore, a select number of demonstration units in different regions/states would help in minimizing this barrier.

Lack of access to credit

Credit facilities such as loans are not accessible to brick manufacturers in the majority of the brick clusters. Coupled with this is the reluctance of brick manufacturers to take loans. This may be due to the fact that they have limited resources in project planning and monitoring.

1.3.1 Prior and on-going assistance

Few institutes from GOI and universities are active in the brick sector. These include the Central Building Research Institute (CBRI), Punjab State Council for Science & Technology (PSCST), and the Aligarh Muslim University (AMU). Some private consultants are also involved in various activities in the sector. The present access of the government institutes is restricted to certain regions of the country. Private consultants undertake different activities ranging from providing technology solutions to developing machinery for (semi-) mechanisation of the brick industry.

The CBRI developed high draft (HD) kiln for brick firing, which has better energy and environment performance. But it could not penetrate brick sector in large scale which may be attributed to poor awareness among the brick manufacturers, higher level of investment required, technological complexity and the need for electricity connections. About 150 HD kilns operate in different parts of the country.

Large-scale interventions in the Indian brick sector are underway in two independent programmes. The Punjab State Council for Science and Technology (PSCST), located at Chandigarh, is involved in a large-scale shift of BTKs from the moving chimney to the fixed chimney type in north India.

Another ongoing intervention is a bilateral assistance programme by the Swiss Agency for Development and Cooperation (SDC), New Delhi under the project 'India Brick Project (IBP)'. Initiated in 1995, the programme comprises activities such as the adaptation and dissemination of a technology of Chinese origin known as the 'Vertical Shaft Brick Kiln (VSBK)', an efficient technology for brick-making. VSBK technology may be one of the options for replacing clamps and small sized BTKs. The energy and environmental performance and working conditions of the VSBK are superior to these kilns. This on-going programme is concentrated mainly in Zone–2 (peninsular India) which accounts for 35% of the total brick production in the country. The programme also aims to catalyze social changes in the Indian brick sector.

But all these efforts, put together, are only sufficient to make a small dent in the sector and may not be able to cater to the entire brick sector in India. Most of these efforts are region/technology specific.

1.3.2 *Project objective*

The development objective of this project is to produce good quality bricks at a low cost without damaging the environment. It is thus required to remove barriers exist in the sector. The project will specifically address these barriers in adopting energy-efficient and environmentally sound technologies. Improved energy efficiency and reduced emissions lead to better local environment. Reduced fuel costs will lead to greater profitability of the brick manufacturers who will be encouraged to invest in other aspects such as health and safety of workers and education to the workers' children. Adoption of these technologies on large scale would also help in reducing consequences of climate change.

1.4 Reasons for assistance

The existing profitability of the brick industry is marginal which may be attributed to high fuel cost (30-40% share in total production costs) and low value of the end product. The new energy efficient technology options need higher investments. The brick manufacturer may not be able to invest from internal resources in current situation. Moreover, loans from banks are also not easily available to the brick industry. It is felt that without external support, it may not be possible for the Indian brick sector to adopt clean efficient technologies.

The present estimated CO_2 emissions[13] from the Indian brick industry are about 41 million tonnes during 2000–01 which account for about 4.5% of the total GHG emissions[14] from India. The high share CO_2 emissions may be attributed to (1) the large number of brick kilns in operation and (2) use of inefficient technologies, which consume at least 15–25% more energy.

The proposed project has the potential to reduce CO_2 emissions substantially. The potential for nation-wide energy conservation and CO_2 reduction in the brick sector will be manifold. The expected savings on account of fuel consumption justifies the establishment of a barrier-removal framework that will be self-sustained after the project intervention.

The financial support from GEF will help in adoption of better technologies and expected to improve the overall performance of Indian brick sector.

1.5 Project description

The project has three main objectives for removal of barriers as explained above are:

- Establishment of an institutional mechanism to facilitate in project implementation (**Immediate objective–1**)
- Capacity-building of the Indian brick industry through improved awareness and training programmes (**Immediate objective–2**)

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[13] Estimates based on field survey

[14] From ALGAS study (October 1998), estimated GHG emissions from India are 258 million tonne as carbon in the year 2000

- Demonstration of energy-efficient and appropriate technology options **(Immediate objective–3)**

With the proposed activities, the project attempts to address the key barriers exist in the Indian brick sector. The project would thus come under Operational Programme-5 of the GEF. The detailed outputs of each objective and the activities involved are described below:

1.5.1 Immediate objective-1

Establishment of an institutional mechanism for meeting the ongoing technological and managerial needs for implementing the project

Output 1.5.1.1 Establishment of Project Management Office (PMO)

Punjab State Council for Science and Technology (PSCST), Chandigarh is the project proponent and the Project Management Office (PMO) will be established in PSCST. PMO will help in monitoring project developments, incorporating feedback and help in the sustainability of the project beyond its duration. The PMO will have one Project Director, one Deputy Project Director, one Finance and Accounts Officer and one Administrative Officer.

Output 1.5.1.2 Prefeasibility reports for project activities

PMO will prepare pre-feasibility reports for making presentations to public, bilateral and financial institutions for making them aware of the various project activities.

Output 1.5.1.3 Establishment of Technology Backup Unit (TBU)

The technology backup unit (TBU) will function under the PMO. It will carry out various project activities and will have 2 senior trainers, 6 trainers and 3 project engineers. The TBU will become self-sustaining after the project and will continue to function in association with the PMO.

Output 1.5.1.4 Creation of pool of trainers

One of the important activities will be the creation of a pool of trainers who will help in imparting training to brick manufacturers and their workmen. The training needs assessment (TNA) for the trainers will be evolved with the involvement of experts in the brick industry. Appropriate training packages for the trainers will be developed. About twenty trainers will be trained during the first year of the project.

Output 1.5.1.5 Infrastructure facilities

The PMO will be established at the office of the project proponent and will effectively utilize the expertise of the technical manpower available with the project proponent in the brick-sector The management set-up of the TBU and associated facilities will be established by the PMO More details about the institutional mechanism are given in **Chapter 4** on "Project strategy and implementation plans".

1.5.2 *Immediate objective-2*

Capacity-building of the Indian brick industry through improved awareness and training programmes.

Output 1.5.2.1 : Promotion of training activities

The promotional activities include providing information related to energy-efficiency improvements in the brick industry through post, e-mail, web-sites, advertisements, etc. The concerned brick industry associations at state and district levels and the AIBTMF will also be actively involved in the promotional activities. PMO will make presentations to all concerned government departments, their related organizations and NGOs. The project will also organize seminars, workshops, exhibitions and conferences at the national, state, district and tehsil levels for all concerned stakeholders.

Output 1.5.2.2 Network of experts/agencies/institutes in the brick sector

The project will establish formal networking with all concerned experts, agencies and institutes both in India and abroad working for the improvement of brick industry. Organisations not working directly for the brick industry but with the potential to help would also be considered for networking. A study tour within the country as well as abroad will be undertaken for this purpose.

Output 1.5.2.3 Training needs assessment (TNA)

The objective of the study is to evolve training needs for brick manufacturers and workmen. A baseline study will be conducted to assess the present situation in the brick industry. The details will cover process followed for brick making, level of mechanisation, soil characteristics, fuel consumption and characteristics, profile of brick manufacturers, resource assessment, pollution assessment and immediate concerns of brick industry. TNA study for brick manufacturers and workmen will be in parallel with TNA study for trainers.

Output 1.5.2.4 Designing training programmes

Training packages relevant to different brick-producing regions of the country will be developed for trainers, brick manufacturers and their workmen as per the needs. The training modules developed will be suitably modified from time to time by incorporating feed backs from training programmes.

Output 1.5.2.5 Implementation of training programmes

The trainers will be provided extensive training on all aspects of brick making. They would be exposed to formal classroom training as well as on-going developments in the field. The trainers who are trained under the project will, in turn, provide training to both the brick manufacturers and the workmen.

It is planned to train a total of 2500 brick manufacturers and workmen of brick kilns in the project period. The training programme will consist of classroom lecturers as well as on-site training at selected brick kilns. The training programme would also help in identifying potential trainers who will be involved in imparting training to brick manufacturers and workmen in remaining regions of the country. The project will provide technical support to these trainers. The training will also serve as a medium for disseminating demonstrated technologies.

Output 1.5.2.6 Monitoring and evaluation of training programmes

The project will identify experts/agencies who will help in monitoring and evaluating the quality of the training. The feedback will be utilised to upgrade the training packages.

1.5.3 Immediate objective-3

Demonstration of energy-efficient and appropriate technology options

Output 1.5.3.1 Identification of appropriate technologies

An assessment of the technology needs of the Indian brick industry will be carried out through surveys, field interactions and regional workshops. Evaluation of various available technological options will help in shortlisting the proven technologies for various regions as per their needs. The process will also involve interaction with all relevant stakeholders such as brick industry,

industry associations, government, (related departments and ministries at state and central levels) regulatory agencies and financial institutions.

Output 1.5.3.2 Preparation of Detailed Project Reports (DPRs) for demonstration projects

DPRs will be prepared for the short listed demonstration projects. The reports will also include the methodology for selection of brick manufacturers wherein the demonstration projects will be implemented, details of technology providers, detailed implementation schedule, etc.

The short listed brick manufacturers for the technology demonstration programme will be signing a memorandum of understanding (MoU) with PMO for implementation and information dissemination about the project. A tripartite agreement between the brick manufacturer, technology provider and PMO for each demonstration project will be executed for effective implementation of the demonstration project.

Output 1.5.3.3 Setting up demonstration units

The project proposes demonstration of 4 different technological options in Indian brick industry. The following technologies will be demonstrated in both zone-1 and zone-2.

- Energy efficient annular kiln
- Multi chamber kiln
- Use of alternate fuels
- Use of internal fuel (fly ash) in bricks

A total of 20 demonstration projects are planned during the project duration. A summary of description of these technological options is shown in **table 1.2.** Since there are wide variations encountered across regions/zones in Indian brick industry in terms of technology production capacity, climatic conditions, fuel used and resource availability, it is proposed to have more than one demonstration unit under each technological option in different regions/zones as indicated in the table.

The demonstration projects are aimed at generating awareness and confidence among brick manufacturers. Active participation of the brick manufacturers during the demonstration phase is envisaged.

Additionally, it is proposed to undertake study tours for interested and potential brick manufacturers to the demonstration units. This is expected to help them to understand the technology and motivate to undertake projects on their own.

The PMO will also identify local financial institutions/banks for providing appropriate credit facilities to brick manufacturers during the project and replication phases. Assistance from national and international experts will also be taken for successful demonstration.

Table 1.2 Demonstration projects planned under the project

S No	Technology option	Description	Number of demo units		
			Zone-1	Zone-2	Total
1	Energy efficient annular kiln	This technology option to be attempted will be both in conventional and zig-zag type kilns The capacity range for the kiln would be 25,000 brick per day Use of insulation, improved brick setting, better draught of kiln, kiln structure and size optimization, fuel feeding arrangements, coal crusher, control and instrumentation for kiln operation will be demonstrated. Anticipated energy savings are 20%.	6	2	8
2	Multi chamber kiln	These are smaller capacity kilns especially to meet the needs of kilns in zone-2. Anticipated energy savings are 25%	-	4	4
3	Use of alternate fuels	Alternate fuels such as sawdust, de-oiled cake, agricultural residues, pine needles, etc will be tried under this. The project would involve fuel preparation and feeding systems About 70% replacement of coal consumption is expected.	4	2	6
4	Use of internal fuel (fly ash) in bricks	Use of fly ash which may be required to be used in certain brick clusters where it would become mandatory to use fly ash as they are located close to coal based thermal power stations. The project would involve mixing, feeding and proportioning, pugging and extrusion activities Anticipated energy savings are 15%.	2	-	2
		Total	12	8	20

Output 1.5.3.4: Monitoring and evaluation

The project will identify experts who will help to carry out independent monitoring and evaluation of the demonstration projects. This will involve carrying out technical audits of the demonstration projects. The technical audit will consist of assessing the energy, environment, quality and techno-commercial viability of the demonstration projects. It will also help in comparing the performance of demonstrated technologies with the baseline.

Output 1.5.3.5 : Development of regional technology packages

Based on the inputs during monitoring and evaluation, appropriate regional technology packages will be developed relevant to different regions of the country This will provide all relevant information related to the technological options.

1.6 Expected end-of-project situation

The project is complementary to the existing on-going activities in Indian brick sector and it is likely to remove barriers from this sector. The project is aimed to improve the awareness on energy conservation opportunities amongst brick manufacturers, who will have access to trained manpower, efficient and appropriate technologies, and credit facilities for adoption of these technologies. At the end, the brick manufacturers (selected for demonstration technologies) will have improved brick-producing technologies with energy savings in the range of 15–25%. The proposed interventions are also expected to improve product quality and better environment reduce wastage thus help in increasing the profit margin of the brick manufacturer. The expected end of the project situation would be as follows:

1.6.1 Improved awareness

Through various awareness aids such as seminars, workshops, presentations, brochures and newsletters and short-films on brick industry, etc. the awareness level of brick industry will improve in terms of better energy utilization, environmental conditions, productivity and quality of product. Information about new and better technologies and operating practices will also be made available to the brick manufacturers.

1.6.2 Availability of a pool of trained manpower at different levels

Training, in technical and managerial aspects will be given at different levels such as managerial, supervisory and workmen levels. This will also help in creating more number of trained manpower which will be available to the industry.

1.6.3 Demonstrated energy-efficient technologies at zone-1 and zone-2 for replication

By the end of the project, the identified energy efficient technologies to improve the process, quality of bricks, reduction in fuel consumption and improved energy efficiency, would have been demonstrated. These demonstration projects in different regions of zone–1 and zone–2 will provide an insight to brick manufacturers to understand the technologies and motivate them to undertake projects on their own.

1.6.4 *Access to technologies through technology providers*

One of the activities under demonstration projects is the creation of a pool of technology providers who will be able to cater to the needs of brick manufacturers. A number of technological options and choice for technology providers will be available for the Indian brick manufacturers.

1.6.5 *Availability of credit facilities from banks and other financial institutions*

The major problem in accessing credit is the absence of the ability to prepare bankable proposals on their own by brick manufacturers. The project proposes to develop this capability. A suitable mechanism will also be developed to facilitate availability of credit to brick manufacturers from financial institutions along with market creation for undertaking energy efficient technology projects.

1.7 Target beneficiaries

The direct and foremost beneficiaries of this project will be brick manufacturers participating in technology demonstration and training programme. They will have better technology with improved energy efficiency (leading to reduced fuel costs or better profitability), reduced emissions (to meet the environmental standards) and investment. The brick manufacturers and workmen from kilns participating in training programmes will have better skills. Availability of trained manpower will improve competitiveness among brick manufacturers and the chances of higher and better wages for workers.

Creation of technology providers and technology demonstration will help the brick manufacturers to access a number of energy efficient technological options. Improved awareness will also generate business opportunities for technology providers. It will also increase the number of bankable project proposals, which will result in easy availability of loans. Local bankers will also have more business and a better understanding of brick sector and competitiveness in the service market. The financial institutions involved in providing credit facilities to brick sector will have a lower risk of default.

Workers in brick kilns and rural population located close to brick kilns will benefit from the improved environment. Increased profitability will also induce brick manufacturers to adopt better technologies and operating practices.

Improved energy-efficiency will help in conserving the natural resources (coal) of the country. Improved technologies and improved operating practices by a large number of brick manufacturers will lead to reduced CO_2 emissions at global level as well as lower levels of emissions at local level.

1.8 Replication, sustainability analysis and risk assessment

1.8.1 Replication

The project involves dissemination of better operating practices and efficient technologies by the Indian brick kilns. The following strategies will help in better replication of the above activities.

(i) Training

Adoption of training (for brick manufacturers and workers) and demonstration projects will help in reducing the overall energy consumption of individual brick kilns. The degree of energy savings depends on how the learnings are adhered to by the individual brick kiln units. It is also a recurring process. The project plans to multiply the number of trainers in each region, who in turn will carry out training activities for brick manufacturers and workers on their own. The technical backup unit (TBU) will provide necessary technical inputs to the trainers from time to time and will also organise training programmes for brick manufacturers and their workers.

(ii) Technology adoption

The demonstration projects, which are region-specific, would help in sensitising brick manufacturers to adopt the demonstrated technologies. Availability of technology providers and access to credit facilities will improve the chances of adopting demonstrated technologies. Also during the training programmes, brick manufacturers and workmen will be taken to demonstration project sites.

1.8.2 Sustainability analysis

PMO will carry out the replication of technologies demonstrated through technology providers and regional partners identified in different regions of the country after the project. The programme will only be sustainable if it addresses a large number of brick manufacturers and convinces them to adopt better technology options and operating practices.

(i) Training

The training activity will be a participatory programme to which brick manufacturers will contribute for their workers to get trained. It is intended to increase the contribution by the trainees gradually so that by the end of the project, the training activity becomes self-sustaining. The industry associations at state and district levels will play an important role in identification and selection of brick manufacturers for the training.

(ii) Technology adoption

It is envisaged that the demonstration projects will encourage adoption of these technologies by the brick manufacturers. Availability of finance will also help the brick manufacturers to adopt these technologies. The PMC will monitor the performance of the technological options adopted during the replication phase and ensure their efficient operation.

(iii) Revolving fund mechanism

In order to make the project sustainable on annual basis even after the specific duration of 5 years, it is proposed to create a revolving fund mechanism in the project. All the brick manufacturers where energy efficient technologies have been successfully demonstrated, commissioned as well as energy savings have been established, would be bound to pay-back the minimum amount equivalent to the grant provided by GEF over a period of 10 years from the date of successful commissioning of the project. Annual instalment would be fixed depending on the energy savings from the new technologies. This amount will be utilized in replicating appropriate technologies and training. This will ensure the sustainability of the project even after the project duration.

Detailed guidelines will be developed for an effective recovery of the fund provided by GEF and utilization of the revolving fund. The guidelines will take into account the basic technology costs, grant availed, rate of return, life of the unit, etc. A close and periodic monitoring of the revolving fund will be carried out by the project.

1.8.3 Risk assessment

(i) Insufficient project integration

The project involves many stakeholders who must work closely together if objectives are to be achieved. During the project lifetime, the PMO will take overall responsibility for ensuring this integration. It is expected that a number of regional implementing agencies would have developed interdependency. The project progress will depend on the co-operation among the partners.

(ii) Insufficient replication

Considering the small energy conservation impact of the 20 demonstration units compared to the total project potential in the sub-sector, insufficient replication poses an important risk. Replication is most dependent on the success of demonstrated technologies, the support of financial institutions, interest of brick manufacturers and the availability of technology packages. However, the mindset of brick manufacturers and local market pressure may sometimes slow down the replication process.

A number of measures are built into the projects to strengthen its replication potential. A number of study tours will be organized for interested brick manufacturers intended to encourage them to undertake projects on their own. The project strategy focuses on making the technology suppliers and credit provider easily available to brick manufacturers. It will be in the interests of these entities to ensure replication after the project.

(iii) Insufficient commitment to replication from demonstration units

The success of the project depends on active participation of brick manufacturer of demonstration unit in dissemination and replication activities. The brick manufacturer could become unwilling to contribute towards post-project activities related to replication. Commitments will be sought from brick manufacturers of demonstration unit to provide necessary information related to demonstration unit for replication and to dissemination of technology.

(iv) Non-availability of contribution from brick manufacturers

GEF will provide only part of the project budget and rest of the investments will be borne by brick manufacturers. Part of the brick manufacturer's share will be the credit from financial institutions who will scrutinise the soundness of the proposal, proposer and the past performance of the individual brick manufacturer. This will ensure that the investment proposals are of high technical quality and financially sound limiting the risk of co-financing from the brick manufacturers.

(v) Poor performance of brick manufacturer after project implementation

Poor technology selection, operation and insufficient market demand for higher quality products pose a risk to overall performance of the brick manufacturer after project implementation. These risks for the market development can be limited by thorough project preparations by an expert in the field.

(vi) Poor loan repayment

Loan repayment depends on the cash flow to brick manufacturers, which is determined by their sales, its cost structure, including production costs and fiscal costs and the local market conditions. Special credit schemes may take care of this risk.

2

Incremental costs and CO_2 abatement costs

The total estimated budget for the project is US$ 6,038,900. The incremental costs for the project is US$ 5,069,760 and balance funds of US$ 969,140 plus the provision of land for the demonstration of technologies will be the contribution of brick manufacturers. The incremental costs for the technology demonstration is calculated by adding annual operation and maintenance costs (at the rate of 5% of technology costs) and discounting coal savings after annualising the present value of technology costs for its life i.e. 20 years. The incremental costs for training component is calculated by annualising it for five years (i.e. project duration) and discounting coal savings per year. **Table 2.1** shows the incremental cost matrix for the project.

The weighted average cost per tonne of CO_2 abated is about US$ 19.3 for technology demonstration projects and about US$ 13.7 for the training. It is estimated that the demonstration units will help in saving 54,730 tonnes of coal during their life. The corresponding CO_2 saving[2.1] is 275,005 tonnes. The CO_2 saving also includes the savings due to replacement of coal by biomass fuels.

Awareness generation through training programmes will reduce coal consumption by about 334,238 tonnes and the corresponding CO_2 abatement will be 571,548 tonnes. The total CO_2 abatement with technology demonstration and training programme would be about 0.85 million tonnes. Details of the incremental costs and CO_2 reduction are shown in **annex 2.1**.

[2.1] There will not be substantial monetary savings by replacing coal with biomass as the cost of biomass will be almost same as of coal for the equivalent heat supply.

Table 2.1 Incremental cost matrix

Component	Baseline	Alternative	Incremental cost
Global environmental benefits: • Total CO_2 abated during life of brick kiln units	0	0.85 million tonne	0.85 million tonne
Total project costs	US$ 969,140 + land costs	US$ 6,038,900	US$ 5,069,760
Establishment of institutional mechanism	Global: Brick kilns emit GHG's — unaware of win-win nature of energy efficiency Domestic· Little or no awareness of energy efficiency Cost : 0	Global: Brick kilns see environmental potential of energy efficiency Domestic: Brick kilns see economic potential of energy efficiency Cost: US$ 2,456,460	Cost: US$ 2,456,460
Capacity-building and Improving awareness	Global: No institutional set-up to deal with issues related to brick sector Domestic: Continue to operate in poor condition Cost: US$ 435,300	Global: Institutional support for social improvement in the sector Domestic: Better operating conditions Cost: US$ 1,085,890	Cost: US$ 650,590
Technology Demonstration	Global: Sector will continue with old inefficient technologies Domestic: Little or no awareness of new efficient technologies, how to arrange finance Cost: US$ 533,840+land	Global: Energy-efficient demonstration plants available for awareness Technology demonstration creation, availability of financial mechanism and technology suppliers Domestic: Adoption of energy efficient technology Cost: US$ 2,496,600	Cost: US$ 1,962,760

3 Project Budget

The total estimated budget for undertaking the training programmes and technology demonstration projects is US$ 6,038,900. The break-up of budget estimates is given in **table 3.1**. The detailed budget estimates are given in **annex 3.1**.

Table 3.1: Cost share of various stakeholders

Budget component	*US$*	*Percentage share*
Total budget	6,038,900	100%
GEF financing	5,069,760	84%
Contribution from brick manufacturers (other than land)	969,140	16%

3.1 Contribution from brick manufacturers

The project proposes participatory approach i.e. brick manufacturers will share the costs incurred in various activities. The activities identified in the project are training programmes & awareness generation and demonstration projects. In training programmes, the initial cost sharing of brick manufacturers would be lower in first few programmes and will be increased in subsequent programmes to attain self-sufficiency. In zone–1, the share of brick manufacturers for the training programme will be 40%, 60%, 75% and 90% during the 2nd, 3rd, 4th and 5th year respectively. In zone–2, the share of brick manufacturers would be 50%, 75% and 90% during the 3rd, 4th and 5th year respectively. The total contribution by the brick manufacturers for the training programmes is US$ 435,300.

In technology demonstration, it is expected that the brick manufacturers will share about 40% of the technology costs for which they may avail credit from banks. The total contribution by the brick manufacturers for the technology demonstration programme is estimated at US$ 533,840. Additionally, the brick manufacturers will also provide the land required for the technology demonstration. Few financial institutes have shown an interest in this. The letter of interest from financial institutions is enclosed in **annex 3.2**.

Thus the total contribution of brick manufacturers towards capacity building and technology demonstration programmes in the brick sector is US$ 969,140 (16% of total budget estimates).

3.2 Contribution from GEF

GEF will meet the expenses incurred in carrying out project activities such as technology demonstration, awareness and training programmes, etc. The contribution from GEF to the project will be US$ 5,069,760 (84% of total budget estimates).

3.3 Cash flow estimation

The project would establish the project management office (PMO) and initiate activities during the first year of the project. Starting from second year, number of training programmes and technology demonstration projects are planned in zone-1 and zone-2 of the brick making regions. The break-up of cash flow estimation for each year is given in **table 3.2.**

Table 3.2 Cash flow estimation

Year	IO-1	IO-2	IO-3	Total
Year-1	526900	196000	70400	793300
Year-2	414900	200800	412100	1027800
Year-3	506700	225000	821200	1552900
Year-4	495100	235200	820100	1550400
Year-5	512900	228800	372800	1114500
Total	2456500	1085800	2496600	6038900

IO-1 - Immediate objective-1 · Institutional mechanism

IO-2 - Immediate objective-2 Capacity building

IO-3 - Immediate objective-3 Setting up of demonstration units

4 Project strategy and implementation plans

4.1 Project strategy

The overall project strategy is to enhance the capability of the local brick industry through awareness and training. The project will help in creating and providing trained manpower to the brick sector. Technology demonstration projects will provide better insight to the brick manufacturers into advanced energy efficient technologies and encourage them to undertake projects on their own. The strategy will also include creation of a pool of technology providers who will provide various technological options for the brick industry. The project also envisages providing suitable credit facilities through financial institutions for investing in energy efficient projects.

A principal indicator for the success of the project is active participation of the brick manufacturers and investments through local financial institutions for energy efficiency- improvements. It is proposed to train 2500 brick manufacturers and workmen and demonstrate 20 energy efficient projects in brick making during the project duration.

Involvement and active participation of financial institutions will ensure sustainability of the project. Availability of trained manpower will improve operating conditions prevailing in brick industry, which at present consists mainly of a traditional system and workmen without any scientific training. The critical assumptions and risks made in the projects, verifiable indicators and sources of verifications are elaborated in logical framework analysis as **annex 4.1.**

4.2 Implementation arrangements

The project will be implemented by the UNDP and executed by the MoEF. A Country Project Coordinator (CPC) will be appointed by UNDP for overall execution of the project. The PSCST will be the project proponent in the proposed programme. A project management office (PMO) will be established under the Executive Director (ED), PSCST. A Project Director (PD) will head the PMO and provide necessary support to the project. A Deputy Project

Director (DPD) in the Technology Backup Unit (TBU) will assist in coordination and execution of all the activities involved in the project execution.

An Executive Committee (EC) will be established by the PMO and headed by the Country Project Coordinator (CPC) appointed by the UNDP. The role of the Executive Committee will be to look after and provide guidelines to the PMO. It will also decide the work plan and recommend various project activities. The Executive Committee will consist of Executive Director-PSCST, members from relevant ministries such as the Ministry of Power (MoP), Ministry of Environment and Forest (MoEF), Ministry of Coal (MoC), Ministry of Industry (MoI), state departments and members from the implementing agency (UNDP), financial institutions, brick associations, central and state pollution control boards and consultants.

A project Steering Committee will be established by the PMO and the Executive Committee. The steering committee will consist of members from the UNDP, Executive Director of project proponent, Secretary-MoEF and the State Secretary for Environment. The state secretary will be from the state environmental department which will be implementing the project. The steering committee will review the overall progress of the project and provide recommendations to the executive committee. The steering committee meeting is scheduled once a year whereas the executive committee will meet once in six months.

Day-to-day progress of the project will be reviewed by the Project Monitoring Cell (PMC) which will function under the PMO It will have members from local, state and national brick associations, financial institutes, project proponent and experts/consultants from the brick industry. There will also be one manager (finance) and one administrative officer in the PMO.

The technical section of the project i.e. imparting training and setting up of demonstration projects will be supported by the Technical Backup Unit (TBU). This will consist of the Deputy Project Director (DPD), Senior Trainers, Trainers, Project Engineers and headed by the Project Director of the PMO. The project will involve agencies/experts for specific input requirements, which could be short- to medium-term. Terms of Reference (TOR) for such activities will be developed as per needs during the project implementation. The institutional mechanism for project implementation is shown in **figure 4.1**.

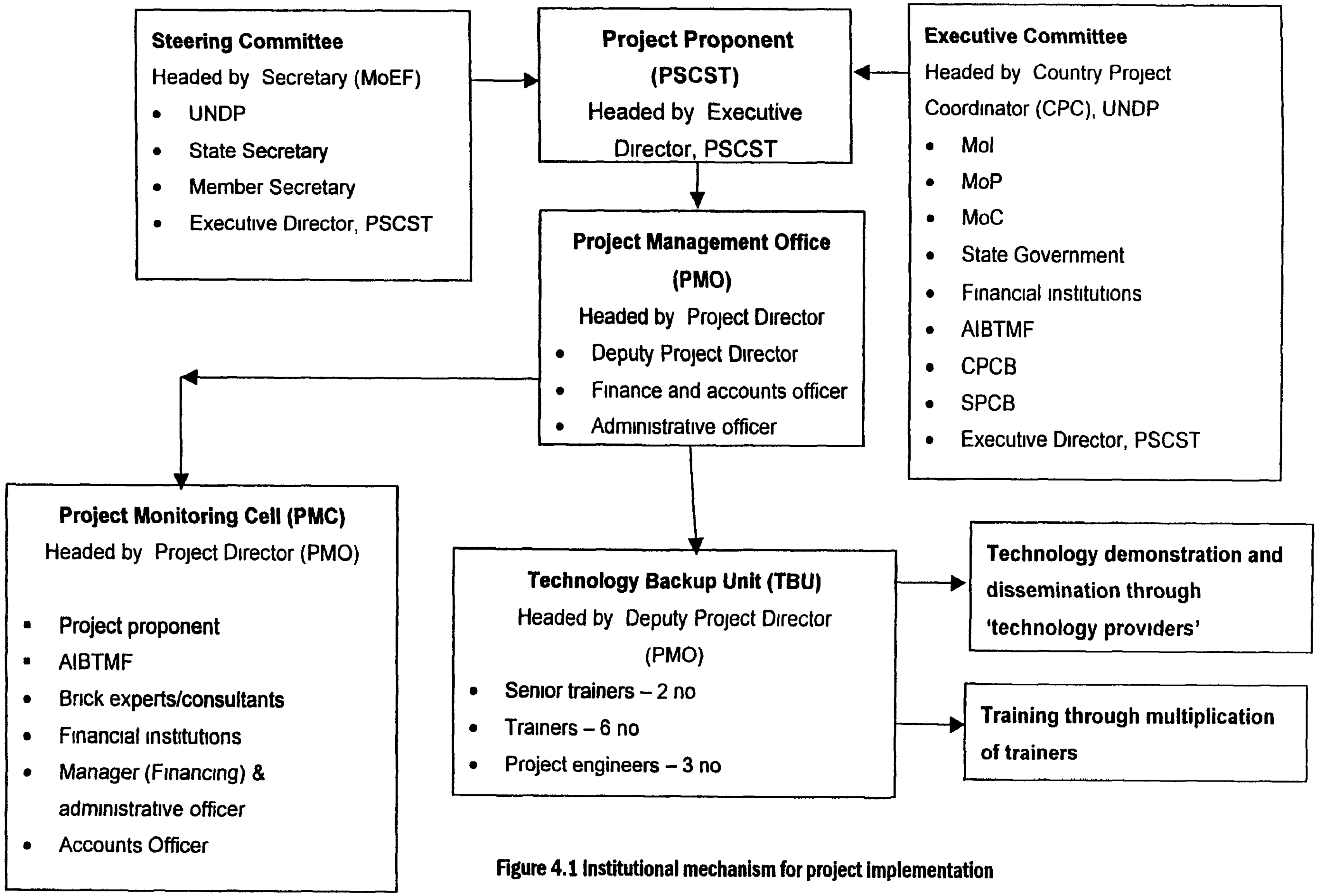

Figure 4.1 Institutional mechanism for project implementation

4.3 Counterpart support capacity

The project proponent, PSCST, is a nodal agency for activities related to industrial development. It has a wide networking with institutions working actively in the Indian brick industry and abroad, experts/ consultants and brick industry associations. This will greatly help in initiating activities as proposed in this project brief. The project proponent has been actively involved during the last five years in transformation of moving chimney BTKs to fixed chimney BTKs in the states of Punjab and other parts of the country. A brief description about the project proponent is given in **annex 4.2**.

4.4 Monitoring and evaluation plan

The steering committee will meet once in a year to review the progress and ensure that the project moves in the right direction. The executive committee will meet once in six months and review the progress made in the previous six months and approve the work plans for the next six months. The PMO will manage the overall implementation of the project at the regional, zonal and country level. It will review the progress of all activities and prepare a quarterly progress report which will be submitted to UNDP. A Project Implementation Review (PIR) will be carried out annually for every year during the project. The PMC will collect data on the performance of pilot projects in terms of product quality, energy conservation and overall project performance indicators. The activity schedule for the project is shown in **annex 4.3**.

The proposed monitoring and evaluation plan (M&EP) for the project is given under three major objectives.

- Setting up of institutional mechanism (M&EP–1)
- Capacity-building for the Indian brick industry (M&EP–2)
- Technology promotion through demonstration units (M&EP–3)

Table 4.1 M&EP-1. Setting up institutional mechanisms

Component	*Indicator*	*Monitoring mechanism*
Establishment of PMO	• PMO in place	• Progress report submitted to UNDP/GEF by PMO
Establishment of Technology Backup Unit (TBU)	• Faculty in place • Availability of trainers	• Progress report submitted to UNDP/GEF by PMO • Report from independent expert
Infrastructure facilities	• Infrastructure such as faculty, testing facilities and hardware in place.	• Progress report submitted to UNDP/GEF by PMO

Table 4.2 M&EP-2 Capacity-building for Indian brick industry

Component	Indicator	Monitoring mechanism
Network of experts	• Contacts with experts and institutes within the country and abroad	• Project progress report
Designing training programmes	• Availability of training modules	• Training reports • Evaluation report by independent expert • Project progress report
Implementation of training programmes	• Training calendar • Number of training programmes/participants	• Feedback from participants • Evaluation report by independent expert • Training/Project progress report

Table 4.3 M&EP-3. Technology promotion through demonstration units

Component	Indicator	Monitoring mechanism
Selection of appropriate technologies	• List of appropriate technologies	• List of technology providers • Project progress report
Detailed project reports (DPRs)	• Tie-up with technology providers • Submission of DPRs to UNDP/GEF	• Technology assessment report • Project progress report
Setting up of demonstration units	• Demonstration units in place	• Physical verification • Project progress report • Local brick manufacturer • Report of financial institution • Performance evaluation report by independent consultant • Regional technology packages for brick industry

Annex 1.1

State reports

The Indian brick industry

Kiln type	Chimney type	Kiln shape	PCS*	Total	Production capacity (number)	Coal consumption (tonne)
BTK	Fixed chimney	Oval	GSC	9194	37,00,000	11 4
BTK	Fixed chimney	Oval	No GSC	10217	38,00,000	16 0
BTK	Moving chimney	Oval	No GSC	12444	27,00,000	15 9
High draft(HD) / Hoffmann	Fixed chimney			549	16,00,000	14 8
Clamps	—			58086	6,00,000	16 6

* PCS – Pollution control system

Number of kilns : 90490
Brick production : 144 billion per year
Coal consumption : 24.2 million tonne
Wood consumption : 2.6 million tonne
Specific energy consumption : 1.34 MJ/kg brick
Total CO_2 generation : 41.6 million tonne

Information on major brick producing states is given in subsequent sections.

- Andhra Pradesh
- Assam
- Bihar
- Goa
- Gujarat
- Haryana
- Himachal Pradesh
- Karnataka
- Kerala
- Madhya Pradesh
- Maharashtra
- Orissa
- Punjab
- Rajasthan
- Uttar Pradesh (including Uttaranchal)
- Tamil Nadu
- Tripura
- West Bengal

Andhra Pradesh

1.0 General information

Area	:	2,75,068 square kilometer
Population	:	7,57,27,541 (2001)
Capital	:	Hyderabad
No. of districts	:	23

Unique features of the industry :

- Majority MCBTK and clamp units use rice husk as external fuel, while its internal is universal
- Use of plastic double moulds
- Use of about 40 % non—brick material such as stones/concrete/mud blocks, etc. wall making.

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total nos	Height of chimney Metre	Average brick production/ season	Average fuel consump (tonne per lakh brick)	
							Coal	Rice husk
BTK	Fixed chimney	Oval	GSC	0	—	—	—	—
BTK	Fixed chimney	Oval	No GSC	—	—	—		—
BTK	Moving chimney	Oval	No GSC	15	—	50,00,000	5 0	25.0
High draft (HD)	Fixed chimney			0	—	—	—	—
Clamps	—			~7,300	—	7,13,698	6 0	30.0
Total number of kilns: 7,315								

Brick making season	:	October — May
Average weight of bricks	:	2.00 kg
Total production in state	:	5,285 million bricks

GCV of fuels:

Coal	:	4500 kcal/kg
Rice husk	:	3000 kcal/kg

Fuel costs:

Coal	:	Rs 1,650 per tonne
Rice husk	:	Rs 500 per tonne

Assam

1.0 General information

Area : 78438 square kilometer

Population : 22 million (estimates for 2000)

Capital : Guwahati

Number of districts : 23

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total nos	Height of chimney	Average brick production/ season	Average fuel consumption (tonne per lakh brick)	
							Coal	Rice husk
BTK	Fixed chimney	Oval	GSC	100	30	35,00,000	20	–
BTK	Fixed chimney	Oval	No GSC	50		35,00,000	20	–
BTK	Moving chimney	Oval	No GSC	350	12	25,00,000	21	–
High draft (HD)	Fixed chimney			2	21	40,00,000	18	–
Hoffman kiln	Fixed chimney	Oval		–	–	–	–	–
Clamps	—			–	–	–	–	–
Total number of kilns: 502								

Brick making season : November to March

Average weight of bricks : 2.3 kg

Total production in state : 1.4 billion bricks

GCV of fuels:

- Coal : 5000 kcal/kg (assumption)
- Rice husk : 3200 kcal/kg (assumption)

Fuel costs:

- Coal : Rs 1,700 per tonne

Bihar and Jharkhand

1.0 General information:

Area : 173877 square kilometer
Population : 86338853(1991)
Capital : Patna (Bihar) and Ranchi (Jharkhand)
Number of districts : 55

Unique features of the industry:

- Use of inferior grade coal slurry cake,
- Coal source: Bihar, Meghalaya, Assam

2.0 Kiln details:

Kiln type	Chimney type	Kiln shape	PCS	Total nos.	Average brick production / season	Average fuel consumption per lakh brick (tonne)	
						Coal	Wood
BTK	Fixed chimney	Oval	GSC	600	2500000	18	2
BTK	Fixed chimney	Oval	No GSC	1200	2000000	18	2
BTK	Moving chimney	Oval	No GSC	3600	1500000	22	3
High draft (HD)	Fixed chimney						
Clamps				600	1000000	25	4
Total number of kilns 6000							

PCS — Pollution control system

Brick making season : December to June
Average weight of bricks : 3.5 kg per brick
Total production in state : 9.9 billion bricks

GCV of fuels used:
Coal : 4200 kcal/kg
Wood : 3200 kcal/kg

Fuel costs:

Coal . Rs 1500 per tonne
(Rs. 3000 for Assam coal)
Wood : Rs 1000 per tonne

2.1 Cost of production

Item	**Cost (Rs/'000bricks)**
Clay winning /purchase of clay including transportation	200
Moulding of raw bricks, drying and stacking (Rs/thousand bricks)	200
Handling of green bricks	60
Setting of green bricks in the kiln	30
Preparation and handling of fuel and firing of bricks	465
Unloading and stacking	45
Administrative staff and other expenses	20
Annual expenses on kiln maintenance	10

Brick selling price (For 1st class/thousand brick):

Maximum : Rs 1500
Minimum : Rs 1300

Goa

1.0 General information

Area : 3,702 square kilometer
Population : 13,43,998 (2001)
Capital : Panaji
Number of districts : 2

Unique features of the industry:

- No internal fuel
- 40 % brick supply comes from outside Goa
- Use of about 50 % non—brick materials like laterite/concrete/ mud blocks etc. for wall making.
- Clay and additives transported from outside

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	*Total* nos	Height of chimney Metre	Average brick production/ season	Average fuel consumption (tonne per lakh brick)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC	0	—	—	—	—
BTK	Fixed chimney	Oval	No GSC	0	—	—	—	—
BTK	Moving chimney		No GSC	0	—	—	—	—
High draft (HD)	Fixed chimney			0	—	—	—	—
Hoffman kiln	Fixed chimney	Oval		1	35	10,00,000	—	12 0
Clamps	—			~16	—	2,00,000		15 0
Total number of kilns 17								

Brick making season : October — May
Average weight of bricks : 2.5 kg per brick
Total production in state : 4.2 million bricks

Fuel particulars:
Coal : 5000 kcal/kg

Fuel costs:
Coal : Rs 2900 per tonne

Gujarat

1.0 General information

Area : 1,96,024 square kilometer
Population : 5,05,96,992 (2001)
Capital : Gandhinagar
Number of districts : 19

Unique features of the industry:

- Use of coal powder/rice husk as internal fuel
- Extensive use of donkeys for material handling
- Use of lignite as fuel in BTKs and Clamps
- Clay source adjacent to moulding site

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total nos	Height of chimney Meters	Average brick production / season	Average fuel consumption (tonne per lakh brick)	
							Coal	Lignite
BTK	Fixed chimney	Oval	GSC	10	36	90,00,000	—	10 0
BTK	Fixed chimney	Oval	No GSC	0	—	—	—	—
BTK	Moving chimney	Oval /	No GSC	590	10	55,00,000	3 0	7 0
High draft (HD)	Fixed chimney			0	—	—	—	—
Clamps	—			3,000	—	7,00,000	5 0	10 0
Total number of kiln 3600								

Brick making season : November to May
Average weight of bricks : 2.3 kg per brick
Total production in state : 5.4 billion bricks

GCV of fuel used:

Coal : 5000 kcal/kg
Biomass : 3200 kcal/kg
Lignite : 3000 kcal/kg

Fuel costs per tonne

Coal	:	Rs 2500
Biomass	:	Rs 1000
Lignite	:	Rs 1000

Haryana

1.0 General information

Area	:	44212 square kilometer
Population	:	21 million (2001 census)
Capital	:	Chandigarh
Number of districts	:	19

Other details about the state:

Haryana can be divided into two natural areas, Sub–Himalayan terrain and the Indo–Gangetic plain. The plain is fertile and the south west of Haryana is dry and sandy.

Building materials

- Brick is preferred as construction material
- Few mechanized brick manufacturing unit have been set–up in the state.
- A cluster of 500 – 600 kilns are operating on the peripheries of Delhi.
- Cement blocks/hollow bricks are rarely used for construction.
- Migratory labour is employed in the brick making. Most of the labour comes from the states of Uttar Pradesh and Bihar.
- **BRICK KILNS**: There are about 2000 bull's trench kilns in the state, out of which 1800 brick kilns operated in the last season i.e. 2000–2001. The state has approximately 200 kilns with moving chimneys and around 15 High Draft Kilns.
- Most of the kilns in the state have fixed chimneys with gravity settling chambers.

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total nos	Height of chimney	Average brick production / season	Average fuel consumption (tonne per lakh brick)	
					Meters		Coal	Lignite
BTK	Fixed chimney	Oval	GSC	1000	33	50,00,000	14	1 0
BTK	Fixed chimney	Oval	No GSC	600	20	45,00,000	16	1 5
BTK	Moving chimney	Oval /	No GSC	200	12	40,00,000	20	2 0
High draft (HD)	Fixed chimney			15	18	45,00,000	12	0 5
Clamps	—			–				
Total number of kiln 1815								

Fuel used : Coal (majority), biomass (sarson turi, wood, saw dust, baggasse in some districts), press mud from sugar mills

2.1 Cost of production

Item	Cost (Rs / 1000 bricks)
Clay winning/ purchase of clay including transportation	80
Moulding of raw bricks, drying and stacking	160
Handling of green bricks	55
Setting of green bricks in the kiln	16
Preparation and handling of fuel & firing of bricks	545
Unloading and stacking	45
Administrative staff and other expenses	20
Annual expenses on kiln maintenance	10

Brick making season : October — December and February — Ju
Weight of bricks : 3 kg per brick
Total production in state : 8.56 billion bricks
Gross calorific value of fuels:
 Coal : 5500 kcal/kg
 Biomass : 3200 kcal/kg
Fuel costs:
 Coal : Rs 4000 per tonne
 Biomass : Rs 1500 per tonne

Brick selling price (For 1st class/thousand brick):

- Maximum : Rs 1300
- Minimum : Rs 1000

Himachal Pradesh

1.0 General information

Area : 55755 square kilometer
Population : 6 million (2001 census)
Capital : Shimla

Labour:

Most of the brick requirement is met from the neighbouring districts of Punjab and there are only 130 kilns in the state. Most of them are the bulls trench kilns and most of the labour comes from the state of Uttar Pradesh.

Building materials:

- Brick kilns are mainly situated in lower regions and construction using bricks is preferred there, whereas in upper Himachal Pradesh locally available stone is used for the construction. However in the certain areas, studies are being conducted for the use of construction materials cement, concrete blocks, etc.

2.0 Kiln details

S.No	Kiln type	Chimney type	Kiln shape	PCS	Total kilns	Height of chimney metre	Average brick production / season	Fuel consumption per lakh brick (tonne)	
								Coal	Wood
1	BTK	Fixed chimney	Oval	GSC	113	33	30,00,000	17	0.5
2	BTK	Fixed chimney	Oval	No GSC	0				
3	BTK	Moving chimney	Oval	No GSC	2	12	27,00,000	20	0.5
4	High draft	Fixed chimney			2	21	30,00,000	14	0.3
Total number of kilns 117									

PCS – Pollution control system

Out of 130 kilns, only 117 kilns worked during the season2000—2001

Fuels used : **Coal, wood**
Source of fuel : Coal from Assam and Jharia; wood available locally

Brick making season : January to June

Weight of bricks : 3 kg per brick
Total brick production : 0.35 billion
Gross calorific value of fuels:
    Coal : 5000 kcal/kg
    Biomass : 3200 kcal/kg
Fuel costs:
    Coal : Rs 3800 per tonne
    Biomass : Rs 1000 per tonne

Market trend:
Class–2 bricks are mainly used for construction in lower regions of Himachal Pradesh cement concrete blocks are also becoming popular. In the middle and upper regions of stone construction is preferred, in some cases wood and stone are also used.

2.1 Cost of production

Item	Cost (Rs / 1000 bricks)
Clay winning/ purchase of clay including transportation	70
Moulding of raw bricks, drying and stacking (Rs / thousand bricks)	147
Handling of green bricks (7 persons are employed)	60
Setting of green bricks in the kiln	16
Preparation and handling of fuel including firing of bricks	555
Unloading and stacking	40
Administrative staff and other expenses	20
Annual expenses on kiln maintenance	8

Brick selling price: (For 1st class/thousand brick)

- Maximum : Rs 1400
- Minimum : Rs 1200

Karnataka

1.0 General information

Area	.	1,91,791 square kilometer
Population	:	52.7 million (2001)
Capital	:	Bangalore
Number of districts	:	20

Unique features of the industry·

- No internal fuel
- Extensive use of moulding tables for green brick making
- All annular kilns built above ground (i.e. absence of trench)
- Bricks fired in MCBTKs called 'chamber bricks'
- About 30% non—brick materials such as laterite/concrete/mud blocks, etc for wall making.

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total kilns	Height of chimney metre	Average brick production / season	Fuel consumption per lakh brick (tonne)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC	–	–	–	–	–
BTK	Fixed chimney	Oval	No GSC	–	–	–	–	–
BTK	Moving chimney	Oval	No GSC	50	11	30,00,000	18	–
High draft	Fixed chimney			2	9	25,00,000	18	–
Clamps				7300		7,00,000	15	–
Total number of kilns 7352								

PCS – Pollution control system

Brick making season	:	October — May
Average weight of bricks	:	2.5 kg
Total production in state	:	5,265 million bricks
GCV of used fuel:		
Coal	:	5000 kcal/kg (assumed)
Wood	:	3200 kcal/kg (assumed)

Fuel costs:

Coal : Rs 3,000 per tonne
Wood : Rs 1,000 per tonne

Kerala

1.0 General information:

Area	:	38,863 square kilometer
Population	:	31.8 million (2001)
Capital	:	Thiruvananthapuram
Number of districts	:	14

Unique features of the industry:

- Extensive use of extruders for shaping
- Use of firewood as fuel
- No internal fuel
- Clamp kiln with side walls and roof (called 'Kerala clamp')
- Use of about 40 % non—brick materials like hollow blocks/laterite/concrete /mud blocks etc. for wall making.
- Clay and additives transported from outside

2.0 Kiln details:

Kiln type	Chimney type	Kiln shape	PCS	Total nos	Height of chimney metre	Average brick production/ season	Average fuel consumption (tonne per lakh brick)	
							Coal	Wood
Tunnel kiln	Fixed chimney	Linear	GSC	1	—	50,00,000	—	40 0
BTK	Fixed chimney	Oval	No GSC	0	—	—	—	—
BTK	Moving chimney	Oval	No GSC	0	—	—	—	—
High draft (HD)	Fixed chimney			0	—	—	—	—
Hoffman & DD kilns	Fixed chimney	Oval		400	30 — 36	9,00,000 (excluding Roofing Tiles)	—	50.0
Clamps	—			5,000	—	5,00,000		40 0
Total number of Kilns: 5401								

Brick making season : December — May
Average weight of bricks : 2.50 kg per brick
Total production in state : 2.86 billion bricks

Gross calorific value (GCV) of fuels:
Wood : 3200 kcal/kg

Fuel costs:
Wood : Rs 1,000

Madhya Pradesh

1.0 General information

Area : 3,08,292 square kilometer
Population : 48.7 million (2001)
Capital : Bhopal
Number of districts : 45

Unique features of the industry:

- Use of rice husk/coal ash as internal fuel
- Use of stone dust as additive
- Use of ghol process for removing coarse impurities such as lime kankar, flint, stones, etc.
- Conical clamps using cowdung cakes as fuel (peculiarity of Bundelkhand region)

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total nos	Height of chimney Meters	Average brick production / season	Fuel consumption (tonne per lakh brick)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC	–	–	–	–	–
BTK	Fixed chimney	Oval	No GSC	2	33	37,50,000	13 0	–
BTK	Moving chimney	Oval	No GSC	55	11	27,50,000	18.0	–
High draft (HD)	Fixed chimney			–	–	–	–	–
Hoffman	Fixed chimney	Oval		–				
Clamps	–			2305	–	5,00,000	14 0	—
Total number of kilns. 2362								

Brick making season : November – May
Average weight of bricks : 2.8 kg
Total production in state : 1.3 billion bricks

GCV of used fuel:

Coal : 5000 kcal/kg
Wood : 3200 kcal/kg

Fuel costs per tonne:

Coal : Rs 1800
Rice husk : Rs 500

Maharashtra

1.0 General information

Area	:	3,07,690 square kilometer
Population	:	96.7 million
Capital	:	Mumbai

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total nos	Height of chimney Meters	Average brick production/ season	Fuel consumption (tonne per lakh brick)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC					
BTK	Fixed chimney	Oval	No GSC	1	33	110,00,000	12	
BTK	Moving chimney	Oval	No GSC	200	11	42,00,000	13	
High draft (HD)	Fixed chimney							
Hoffman	Fixed chimney	Oval						
Clamps	—			16000		5,00,000	15	
Total number of kilns 16201								

Brick making season	:	November — May
Average weight of bricks	:	2.5 kg
Total production in state	:	8.85 billion bricks

GCV of used fuel:

Coal	:	5000 kcal/kg

Fuel costs per tonne:

Coal	:	Rs 1900

Orissa

1.0 General information

Area : 155,707 square kilometer
Population : 31 million
Capital : Bhubaneshwar
Number of districts : 30

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total kilns	Height of chimney metre	Average brick production/ season	Fuel consumption per lakh brick (tonne)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC	—	–	–		–
BTK	Fixed chimney	Oval	No GSC	3	32	25,00,000	35	–
BTK	Moving chimney	Oval	No GSC	1200	12	25,00,000	35	–
High draft	Fixed chimney			–	–	–		–
Clamp	—	—		4000		500,000	35	–
Total number of kilns 5203								

PCS - Pollution control system

Brick making season : November –June
Average weight of bricks : 4 kg per brick
Total production in state : 5.1 billion bricks
GCV of fuels used:
Coal : 4200 kcal/kg
Wood : 3200 kcal/kg
Fuel costs:
Coal : Rs 950 per tonne
Wood : –

Brick selling price (For 1st class/thousand brick):

- Maximum : Rs 1700

Punjab

1.0 General information

Area : 50362 square kilometer
Population : 24.3 million (2001 census)
Capital : Chandigarh

Building materials:

- Brick is the main building material used for construction in Punjab.
- Recently 3—4 flyash—clay bricks and fly—ash—cement block manufacturing u have been set up in the vicinity of thermal plants. But clay bricks are preferred and a result number of brick kilns come up every year.
- Mostly migratory labour is employed from the states of Utter Pradesh, Bihar a Rajasthan.

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total kilns	Height of chimney metre	Average brick production/ season	Fuel consumption per lakh brick (tonne)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC	2020	35	53,00,000	13.5	1 0
BTK	Fixed chimney	Oval	No GSC	410	30	47,00,000	15	1.5
BTK	Moving chimney	Oval	No GSC	50	12	45,00,000	17	2.0
High draft	Fixed chimney	—	—	20	18	49,00,000	12	0.5
Total number of kilns . 2500								

PCS – Pollution control system

Out of 2700 bull's trench kilns in the state, about 2500 brick kilns operated during 2000 2001.

Fuel used : Coal, biomass (wood, sawdust)

Brick making season : January — June
Average weight of bricks : 3 kg per brick
Total production in state : 12.9 billion bricks

GCV of fuels used:

Coal : 5500 kcal/kg
Wood : 3200 kcal/kg

Fuel costs:

Coal : Rs 4000 per tonne
Wood : Rs 2000 per tonne

2.1 Cost of production

Item	Cost (Rs per 1000 bricks)
Clay winning/ purchase of clay including transportation	100
Moulding of raw bricks, drying and stacking	200
Handling of green bricks	65
Setting of green bricks in the kiln	15
Preparation and handling of fuel & firing of bricks	578
Unloading and stacking	55
Administrative staff and other expenses	18
Annual expenses on kiln maintenance	10

Brick selling price: (For 1st class/thousand brick)

- Maximum : **Rs 1400**
- Minimum : **Rs 1100**

Rajasthan

1.0 General information

Area : 3,42,239 square kilometer
Population : 56.4 million
Capital : Jaipur

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total nos	Height of chimney Meters	Average brick production/ season	Fuel consumption (tonne per lakh brick)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC					
BTK	Fixed chimney	Oval	No GSC	341	33	50,00,000	16	1
BTK	Moving chimney	Oval	No GSC	500	11	45,00,000	19	2
High draft (HD)	Fixed chimney			9	8	60,00,000	15	1
Hoffman	Fixed chimney	Oval						
Clamps	—			150		20,00,000	25	5
Total number of kilns: 1000								

Brick making season : January — June
Average weight of bricks : 2.8 kg
Total production in state : 4.3 billion bricks

GCV of used fuel:
Coal : 5500 kcal/kg
Biomass : 3200 kcal/kg

Fuel costs per tonne:
Coal : Rs 2500
Biomass : Rs 1300

Tamil Nadu

1.0 General information

Area	:	1,30,058 square kilometer
Population	:	62.1 million
Capital	:	Chennai

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total kilns	Height of chimney metre	Average brick production/ season	Fuel consumption per lakh brick (tonne)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC					
BTK	Fixed chimney	Oval	No GSC					
BTK	Moving chimney	Oval	No GSC	2350		30,00,000	19	
High draft	Fixed chimney			5		45,00,000	18	
Clamp	—			12,500		9,00,000	18	
Total number of kilns . 14855								

PCS – Pollution control system

Brick making season	:	January — July
Average weight of bricks	:	2.5 kg per brick
Total production in state	:	18.3 billion bricks
GCV of fuels used.		
Coal	:	5000 kcal/kg
Wood	:	3200 kcal/kg
Fuel costs:		
Coal	:	Rs 1700 per tonne

Brick selling price (For 1st class/thousand brick):

- Maximum : Rs.1700

Tripura

1.0 General information

Area	:	10,486 square kilometer
Population	:	2.75 million (estimates for 2000)
Capital	:	Agartala
Number of districts	:	4

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total nos	Height of chimney Metre	Average brick production/ season	Average fuel consumption (tonne per lakh brick)	
							Coal	Rice husk
BTK	Fixed chimney	Oval	GSC	–				–
BTK	Fixed chimney	Oval	No GSC	10	30	27,50,000	18	—
BTK	Moving chimney	Oval	No GSC	82	12	18,00,000	24	—
High draft (HD)	Fixed chimney			8	21	22,50,000	15	—
Hoffman kiln	Fixed chimney	Oval		—	—	—	—	—
Clamps	—			—	—	—	—	—
Total number of kilns: 100								

Brick making season	:	November — March
Average weight of bricks	:	4.3 kg
Total production in state	:	0.19 billion bricks
GCV of fuels:		
Coal	:	5000 kcal/kg (assumption)
Rice husk	:	3200 kcal/kg (assumption)
Fuel costs:		
Coal	:	Rs 2,250 per tonne

Uttar Pradesh and Uttaranchal

1.0 General information

Area : 294413 square kilometer
Population : 139 million (1991)
Capital : Lucknow (Uttar Pradesh) and Dehradun (Uttaranchal)
Number of districts : 83

Unique features of brick industry

- Use of various grades coal
- Coal source – Bihar, Meghalaya, Assam and Madhya Pradesh
- Use of sugar candy waste from sugar industry in west Uttar Pradesh
- Use of firewood

Places visited during field survey:

Aligarh, Meerut, Bareily, Lucknow, Muzzafar Nagar, Roorkee, Saharanpur

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total kilns	Height of chimney metre	Average brick production/ season	Fuel consumption per lakh brick (tonne)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC	1000	33	4000000	17	1
BTK	Fixed chimney	Oval	No GSC	7300	33	4000000	18	1
BTK	Moving chimney	Oval	No GSC	5200	11	3000000	20	2
High draft	Fixed chimney	—	—	10	21	5000000	13	1
Total number of kilns 13510								

PCS – Pollution control system

Brick making season : December – June
Average weight of bricks : 3 kg per brick
Total production in state : 48.8 billion bricks

GCV of fuels used:

Coal : 4600 kcal/kg
Wood : 3200 kcal/kg

Fuel costs:

Coal : Rs 2500 per tonne

Wood : Rs 1000 per tonne

Brick selling price (Rs per 1000 bricks: for Class–1bricks)
Maximum : Rs 1300
Minimum : Rs 1100

2.1 Zone—wise brick kilns conversion status in Uttar Pradesh

Zone	Total kilns	Converted to fixed chimney	Likely to be converted
Western	3500	3300	200
Eastern	5000	3000	3000
Central	5000	2000	2000

West Bengal

1.0 General information

Area : 88,752 square kilometer
Population : 68 million (estimates for 2000)
Capital : Kolkata
Number of districts : 18

2.0 Kiln details

Kiln type	Chimney type	Kiln shape	PCS	Total kilns	Height of chimney metre	Average brick production/ season	Fuel consumption per lakh brick (tonne)	
							Coal	Wood
BTK	Fixed chimney	Oval	GSC	2000	30	25,00,000	23	0.5
BTK	Fixed chimney	Oval	No GSC	300	—	25,00,000	24	-
BTK	Moving chimney	Oval	No GSC	350	—	18,00,000	25	0.5
High draft	Fixed chimney	—	—	75	—	30,00,000	20	0.3
Total number of kilns : 2725								

PCS – Pollution control system

Brick making season : November – May
Average weight of bricks : 3.75 kg per brick
Total production in state : 6.62 billion bricks
GCV of fuels used:
- Coal : 5000 kcal/kg
- Wood : 3200 kcal/kg

Fuel costs:
- Coal : Rs 2450 per tonne
- Wood : Rs 1000 per tonne

Brick selling price (Rs per 1000 bricks: for Class–1 bricks)
Maximum : Rs 1600
Minimum : Rs 1500

Annex 1.2

Meeting with stakeholders

Meeting with stakeholders

A stakeholder meeting was organized by the project proponent, Punjab State Council for Science and Technology (PSCST), Chandigarh on August 10, 2001 to receive the views of brick kiln manufacturers and brick associations. Representative brick manufacturers from the following states participated in the workshop.

- Punjab
- Haryana
- Himachal Pradesh

Methodology for discussion

1. Participants were divided into three groups
2. Moderated by one project member, a discussion was initiated for providing views on questions thrown open to the groups
3. A brief presentation by each group was made. One brick manufacturer from each group presented the group's views.
4. A summary of the recommendations was made by the project proponent

Issues posed to brick manufacturers and associations

1. Changes occurred in the brick industry over the last five years
2. Important issues facing the brick industry
3. Role of PSCST in addressing these issues

Question 1. Changes occurred in last five years

Group–1

- Attitudinal changes amongst the kiln manufacturers
- Increased confidence to adopt new technologies e.g. adoption of new fixed chimney designs and gravity settling chambers
- Increased awareness among workers regarding their rights.
- Better interaction and communication between brick kiln manufacturers mainly, to deal with kiln operation and adoption of new designs
- Expanded markets – from catering to a small radius, now able to supply bricks even 200 km away.
- Coal savings, environmental improvements (reduced emissions) to meet emission standards, improved product quality.

Group–2

- Adoption of improved fixed chimney system– coal consumption reduced by about 10% and some reduction in pollution. However, at some places, the workmen were not able to control the higher draughts resulting in underfired bricks at the top of brick setting.
- Increased awareness amongst brick kiln manufacturers regarding new technologies
- Production increased as a result of higher draught available in the kiln. Overall production has gone up, resulting in higher consumption of coal and the coal dealers have benefited the most from this changeover.

Group–3

- Awareness in trade
- Changes in technology – availability of improved designs.
- Increased production
- Decrease in cost of production and consumption of coal
- Control of pollution

Question 2. Issues felt important by the brick manufacturers which need to be tackled

Group–1

- Absence of training facility/institutes for training manpower at all levels (manufacturers, supervisors, labours)
- Absence of laboratory facilities for testing of fuel and clay.
- Absence of R&D fund.
- Need for mechanization. Appropriate technologies required for mechanization.
- Need for entry barrier (regulation on establishment of new brick-making enterprises). Need for legislation in this regard.

Group–2

- Utilization of alternate fuels (biomass briquettes, agriculture residue, and rejected coal from powerhouse).
- Need to improve quality of bricks to increase profitability.
- Need for entry barriers.

Group–3

- Lack of training — workers, supervisors, brick manufacturers
- Non-availability of latest technology
  - Coal consumption
  - Clay preparation
- Limited availability of good clay

- Non-availability of skilled labour
- Limited knowledge of brick manufacturers

Question 3. Suggestions to PSCST regarding its future role in brick industry

Group–1

- Setting up of training facility/institutes for conducting training at various levels (manufacturers, supervisors, labours)
- Setting up of laboratory facility including ceramic testing in association with district and state-level brick associations.
- PSCST to guide government in framing of appropriate legislations for brick industry.
- Providing common platform for discussing problems faced by brick manufacturers with the government
- Assist in development/demonstration of sustainable alternative technology for brick moulding, utilization of alternative fuel and raw material (inferior clays) and new products (including perforated bricks)

Group–2

- Establish training institute
- R&D centre (funded jointly by brick manufacturers and government)
- Work in technology development for mechanization; mechanical coal feeding (coal stoker) etc.
- Laboratory facilities for testing of fuel, raw materials at local level.
- Council should act as an advisor to government on all issues (including labour, food & supplies) related with brick industry.
- Council should help in getting soft loans from banks to brick kiln manufacturers

Group–3

- Training facility and programme to train workers/supervisors. Emphasis should be on trainers. The training should cover both theoretical and practical training
- Appropriate technology for semi-mechanization
- Introduce high-efficiency kilns
- Alternative methods for clay preparation, use of additives, etc
- Barriers to the entry of new kilns
- Laboratory facilities for testing of coal and clay

Conclusions

The summary of issues that emerged during the meeting are:

- Setting up of training facilities and create trainers as well as trained personnel
- Looking for sustainable alternative for technology/raw material, product and fuel
- Setting up of laboratory facilities at cluster and district levels which would help the brick manufacturers in that vicinity to utilize the available facilities
- Legislation framing should be catalysed
- Creation of R&D fund
- Availability of soft loans

Annex 2.1

Incremental costs and CO_2 abatement costs

Incremental costs and CO_2 abatement costs

Broad development goal

The development goal is to prepare the brick industry to operate in a framework that gives financial strength and access to modern technologies to the sector. This will lead to the production of good quality bricks at competitive prices as well as sustainable economic development of the brick sector. This will also result in efficient production of bricks causing minimal damage to the environment which will also help in global efforts to minimize climate change.

Baseline

Various technologies presently used by Indian brick industry are:

1. Clamps
2. Bull's trench kiln (BTK) with fixed chimney
3. Bull's trench kiln (BTK) with moving chimney
4. High draft kilns/Hoffman kilns

Moving chimney BTKs for brick making are being banned since June 2002 through a notification of the Ministry of Environment and Forests (MoEF). The production share of high draft kilns/Hoffmann kilns is insignificant (0.6%). Fixed chimney BTKs contribute for about 73% of the total brick production. Since fixed chimney BTK represents major share of brick production, it may be considered as the baseline technology". BTKs are cheap and less efficient in comparison with the proposed technologies.

An assessment of the brick industry (**annex 1.1**) during mid 2001 indicates that brick production from clamp kilns account for about 26% although they form a share of 65% of total number of brick manufacturing units in India. This may be attributed to the low capacities of the clamps.

An assessment of the current situation points to several barriers which prevent the significant energy conservation potential of brick industries in India from being achieved. The first is a lack of awareness and information about the potential benefits of increased energy efficiency. Second is the non-availability of trained manpower. There are very few trained masons who can take up the current requirement of brick industry. Similarly, very few people are available who can fire the kiln properly. The third barrier is non-availability of finance to brick manufacturers. This may be due to the limited ability of brick manufacturers to prepare a bankable project report. Additionally, there is an apprehension among brick manufacturers that the energy efficient technologies are not affordable. The fourth barrier that hinders the development of a more energy efficient industry is the lack of demonstration units of enhanced energy efficient technologies. These would inculcate confidence among brick manufacturers to invest in energy-efficient kilns resulting in better quality bricks and higher productivity. To remove these barriers, it is felt that GEF funding will be useful.

Global environmental objective

The global environmental objective of this project is the reduction of GHG emissions from the Indian brick sector. This objective will be achieved by removing the barriers that have been identified to the improvement of the efficiency of energy-use in this sector. This is consistent with the goals and guidelines of GEF Operational Program 5 - Removal of barriers to energy conservation and energy efficiency.

Alternatives

The following technologies are proposed for demonstration which will be alternatives for existing brick kilns. These technological options are expected to save energy of the order of 15 to 25%. These demonstration projects are expected to cover a wide range of technology requirements in different regions of the country.

1. Energy efficient annular kiln
2. Multi chamber kiln
3. Use of alternative fuels
4. Use of internal fuel (fly ash) in bricks

It is also planned to impart training to the existing BTKs. Training programme will be carried out for the brick manufacturers and the their workmen. It will focus on better operating practices for brick kilns with an estimated energy saving potential of 10%.

1. Technology demonstration projects

There are four technologies identified for demonstration in Indian brick sector. These technologies are chosen on the basis of past performance, regional requirements, potential energy savings and GHG savings. The demonstration schedule for each technology is given in **table 2.1.1.** These demonstration projects are expected to cover a wide range of capacities and technologies of brick kilns that exist in the country.

Table 2.1.1 Technology demonstration

Technologies	Total demo units	Year–1	Year–2	Year–3	Year–4	Year–5
1 Energy efficient annular kiln	8	0	1	3	3	1
2 Multi chamber kiln	4	0	1	1	1	1
3 Use of alternate fuels	6	0	1	2	2	1
4 Use of internal fuel (fly ash) in bricks	2	0	0	1	1	0
Total demonstration units	20	0	3	7	7	3

It is proposed that brick manufacturers of the demonstration units will be sharing 40% of the technology costs. They will also share information freely regarding the performance of demonstration units. It is hoped that these demonstration units will help build the necessary confidence in the brick industry to motivate them to adopt these technologies. Along with the technology demonstration, a number of study tours for the interested manufacturers are also planned which will motivate them to undertake projects on their own.

2. *Generation of awareness and training programmes*

The Indian brick industry faces a shortage of trained manpower. Existing manpower is not aware of efficient operation of brick kilns. The training programmes on the issues related to energy conservation are very limited, being conducted by few consultants confined to few specific regions of the country.

To spread awareness of efficient brick manufacturing, specific training programmes will be organised separately for brick manufacturers and their workmen. These programmes will cover issues related to better operational practices, mechanisation, productivity, new efficient technologies, preparation of financial proposals, etc besides issues related to energy and environment. It is proposed to train a total of 2500 persons covering both brick manufacturer and their workmen in five years. Training programmes will start from the second year of the project, and the schedule is given in **table 2.1.2**.

To build commitment into the training programme, a part of the training costs will be borne by the brick manufacturers (**section 3.1**). The share of brick manufacturers will be lowest in the year of commencement and will be increased over subsequent years. At the end of the project, it is aimed to generate all the funding requirements for training from brick manufacturers only, which will also help in the sustainability of the training programmes.

Table 2.1.2 Schedule for training programmes

Component	Total units	Year–1	Year–2	Year–3	Year–4	Year–5
Number of training programmes	84	0	16	22	22	24
Number of persons trained	2500	0	500	650	650	700

Incremental costs

Under the baseline conditions, the limited awareness and knowledge base, the weak institutional structure, and the limited capabilities of the brick manufacturer to obtain loans for energy-efficiency investments will continue to constrain the energy-efficiency in Indian brick sector. The estimated emissions of CO_2 from Indian brick industry are 41 million tonnes per year which will continue to increase if there are no investments to improve the energy efficiency.

It is expected that execution of the project with grants provided by GEF will help in removing the identified barriers, and the brick manufacturers will start investing in energy efficient technologies. These investments will result in energy savings and reduced CO_2 emissions.

The total budget estimates for the proposed project is US$ 6,038,900. The incremental costs are estimated to be US$ 5,069,760. The remaining US$ 969,140 will be contributed by the brick manufacturers. This will cover part of cost sharing in training programmes and technology costs. It is planned that every year the project will increase the share of brick manufacturers towards training programme costs and subsequently to manage the programme costs for training from the contribution of brick manufacturers. It is also assumed that 40% of the technology costs will be borne by the brick manufacturers for technology demonstration apart from providing land (**section 3.1**). Apart from this contribution, the brick manufacturers will also provide the required land for the technology demonstration. The contribution from brick manufacturers includes loans to be availed from the financial institutions.

The weighted average cost of CO_2 abatement is worked out to be US$ 19.3 per tonne of CO_2 abated for the technology demonstration and US$ 13.7 per tonne of CO_2 avoided for training. It is expected that with the project intervention, CO_2 emissions will be reduced by about 0 85 million tonnes (**table 2.1.3**). Detailed incremental cost calculations and assumptions are shown in the table.

Table 2.1.3 Incremental costs and CO_2 abatement costs

Technologies	Number of demo units	Production per demo unit (million bricks per year)	Anticipated energy savings (%)	Technology cost per demo unit (US$)	Annual investment per million bricks per demo unit (US$)	Annualized incremental technology cost per million bricks per demo units (US$)	Annual coal savings per million bricks per demo unit (tonne)	CO_2 abated per million bricks per year per demo unit (tonne)	Cost avoided (US$/tonne of CO_2)
Energy-efficient annular kiln	8	7 5	20	155652	20754	855	33 7	57	14 8
Multi chamber kiln	4	2 0	25	101468	50734	3680	42 1	72	51 1
Use of alternative fuels	6	7 5	70*	90652	12087	1358	0*	201	6 7
Use of internal fuel (fly ash) bricks	2	7 5	15	114452	15260	501	25 3	43	11 6
								Weighted average	19 3
Training programme (number of persons to be trained)	2500	397	10%	3542348	8924	393	16 8	28 8	13 7

Total coal saved with technology demonstration and training = 388,968 tonne

Total CO_2 abated with technology demonstration and training = 846,552 tonne

* Replacement of coal by biomass

Methodology

A spreadsheet has been used to calculate annualized incremental costs (AIC) for one demo unit in each technology category.

AIC = ACC + IO&M – AFS
ACC = Annualized capital costs
= CRF * CC
IO&M = Incremental operating and maintenance cost
= 5% of technology costs
AFS = Annual fuel savings
CC = Capital cost per demo unit

$$CRF = \frac{r}{1-(1+r)^{(-n)}}$$

where, r – discount rate = 7%

n – life of technology; (20 years for the technologies demonstrated, and the effect of training is taken for a period of 10 years)

- Technology cost per demo unit includes basic technology costs and other associated project costs

Annex 3.1

Budget estimates

Budget estimates

The total estimated budget for the project "Energy efficiency improvement in brick sector" is US$ 6,038,900. The brick manufacturers will also contribute to the project. The brick manufacturers and their workmen who will be imparted training to improve the kiln operating practices will share part of the training programme expenses. The share varies between 40% to 90% with the progress of the project. The brick manufacturers will share 40% of the technology costs for demonstration units. They will also provide land for the technology demonstration. The detailed budget estimates are shown in the following sections.

Immediate objective-1: Institutional mechanism for implementation

			Year 1 Zone-1	1 Zone-2	2 Zone-1	2 Zone-2	3 Zone-1	3 Zone-2	4 Zone-1	4 Zone-2	5 Zone-1	5 Zone-2	Tot budget for 5 yr
		Salary hike planned per year	10%										
		Total salary	110%										
1.1	**Establishment of project mangement office (PMO)**												
	1 1 1	Setting up of PMO											
	1 1 1 1	Project Director	18000		19800		21800		24000		26400		
	1 1.1 2	Deputy Project Director	17000		18700		20600		22700		25000		
	1 1 1 3	Finance & Accounts officer-1	10000		11000		12100		13300		14600		
	1 1 1 4	Administrative officer-1	8800		9700		10700		11800		13000		
	1 1 1 5	Secretary	6000		6600		7300		8000		8800		
	1.1 2	Recruitments	5000										
	1 1 3	Meetings	10000		11000		12100		13300		14600		
			74800	0	76800	0	84600	0	93100	0	102400	0	431700
1.2	**Pre-feasibility reports on project activities**												
	1 2 1	Prefeasibility report on institutional setup	20800										
	1 2 2	Presentation to various stakeholders	6300										
			27100	0	0	0	0	0	0	0	0	0	27100
1.3	**Establishment of Technology Backup Unit (TBU)**												
	1.3 1	*Senior trainers-2*	*27500*		*30300*		*33300*		*36600*		*40300*		
	1 3 2	*Trainers-6*	*60000*		*66000*		*72600*		*79900*		*87900*		
	1 3 3	*Project engineers-3*	*26300*		*28900*		*31800*		*35000*		*38500*		
	1 3 4	*Administrative expenses (Secretaries - 2 no. Technician-1 no. Lab assistant-1 Peon-1)*	*14600*		*16100*		*17700*		*19500*		*21500*		
	1.3 5	*Experts*	*20800*		*20800*		*20800*		*20800*		*20800*		
			149200	*0*	*162100*	*0*	*176200*	*0*	*191800*	*0*	*209000*	*0*	***888300***
1.4	***Pool of trainers***												
	1 4 1	*Training need assessment (TNA) for trainers*											
	1 4 2	*Evolving specific training needs for trainers*											

		Year										
		1 Zone-1	1 Zone-2	2 Zone-1	2 Zone-2	3 Zone-1	3 Zone-2	4 Zone-1	4 Zone-2	5 Zone-1	5 Zone-2	Tot budget for 5 yr
1 4 3	Designing training package for trainers											
1 4 4	Training program for Trainers(for 20 persons for 3 months)	100000				35000						
		100000	0	0	0	35000	0	0	0	0	0	**135000**
1.5	**Infrastructure facilities**											
1 5 1	Rental for building (includes space for institute to operate training centre, lab facilities, rooms for trainers and support staff, governing council members with maintenance)	50000		55000		60500		66600		73200		**305300**
1 5 2	Testing and monitoring facilities (can also be used for hands on training)	20800		21632		22497	22497	9336	4724	4913	4913	
1 5 3	Training facilites (computers, telephone, fax, OHP, slide projector, chairs-30 no tables)	12500		1300		1352		1406		1462		
1 5 4	Transport facilities (4 no @ 30,000 per month)	30000		31200		32448		33746		35096		
1 5 5	Operating expenses (Communication, TA, DA, stationery)	62500		66875		71556		76565		81925		
		175800	0	176007	0	188354	22497	187654	4724	196596	4913	**956545**

Year	Zone-1	Zone-2
Year-1	526900	0
Year-2	414907	0
Year-3	484154	22497
Year-4	472554	22497
Year-5	507996	4913
subtotal	2406510	49908
Budget for Immediate objective-1	**2456418**	

Immediate objective-2: Training needs

			Year										
			1 Zone-1	1 Zone-2	2 Zone-1	2 Zone-2	3 Zone-1	3 Zone-2	4 Zone-1	4 Zone-2	5 Zone-1	5 Zone-2	Tot budget for 5 yr
2.1	**Promotion of training activities**		16700	4200	10816	4368	11249	4543	7087	4724	4913	4913	
	2 1 1	Mailing information through post, email, website											
	2 1 2	Presentations to government departments, bodies, NGOs, associations, brick manufacturers											
	2 1 3	Advertisements											
	2 1 4	Organizing seminars/ workshops/ exhibitions/ conferences at national, state, district and tehsil levels for stakeholders											
			16700	4200	10816	4368	11249	4543	7087	4724	4913	4913	73513
2.2	**Network of experts/agencies/institutes in brick sector**												
	2 2 1	Networking with international institutes (shortlisted)	6300		4368		2271		2362		2457		
	2 2.2	Networking with Indian brick experts	6300		4368		2271		2362		2457		
			12600	0	8736	0	4540	0	4724	0	4910	0	35510
2.3	**Training need assessment (TNA)**												
	2 3 1	Visits to brick industries/study tour (national/ international)	20800										
	2 3.2	Baseline study	52100										
	2.3 2.1	Basic data such as technology, total number of kilns, production capacity, process, fuel consumption, resource assessment and pollution assessment											
	2.3 2.2	Study the profile of brick manufacturers											
	2 3 2 3	Immediate concerns of the industry											
	2 3 2 4	History and status compliance of regulations											

			Year 1	1	2	2	3	3	4	4	5	5	Tot budget for 5 yr
			Zone-1	Zone-2	Zone-1	Zone-2	Zone-1	Zone-2	Zone-1	Zone-2	Zone-1	Zone-2	
	2 3 3	Conducting TNA survey on	12500										
	2 3 3 1	Brick manufacturers											
	2 3 3 2	Workers											
	2 3 4	Evolving specific training needs for (assessment of minimum training needs)	12500										
	2 3 4 1	Brick manufacturers											
	2 3 4 2	Workers											
			97900	0	0	0	0	0	0	0	0	0	97900
2 4	**Designing training programs**												
	2 4 1	Identification/selection of locations	4200		2184	2184	2271	2271					
	2 4 1 1	Central											
	2 4 1 2	On-site											
	2 4 2	Identification/selection of trainers											
	2 4 3	Designing regional training packages	45800			32552	11249			11699			
	2 4 3 1	Training needs of brick manufacturers											
	2 4 3 2	Training needs of workers											
			50000	0	2184	34736	13520	2271	0	11699	0	0	114410
2.5	**Implementation of training programs**												
	2 5 1	Training programs for brick manufacturers			75816		78849	22497	82003	35208	85283	36617	
	2 5 2	Training programs for workers			43368		45103	11249	46907	11699	48783	12167	
			0	0	119184	0	123951	33746	128909	46907	134066	48783	635546
2 6	**Monitoring and evaluation of training programs** (2 persons + 1 secretary + travel costs who will carry out monitoring and evaluation in both Zone-1 and Zone-2)		14600		20800		20800	10400	20800	10400	20800	10400	
	2 6 1	Identification of monitoring and evaluation of agencies											
	2 6 2	Designing suitable monitoring system and formats											
	2 6 3	Compilation and analysis											

Year										Tot budget for 5 yr
1	1	2	2	3	3	4	4	5	5	
Zone-1	Zone-2	Zone-1	Zone-2	Zone-1	Zone-2	Zone-1	Zone-2	Zone-1	Zone-2	

Year	Zone-1	Zone-2
Year-1	191800	4200
Year-2	161720	39104
Year-3	174060	50960
Year-4	161520	73730
Year-5	164689	64097
subtotal	853790	232090
Budget for Immediate objective-2	**1085880**	

Immediate objective-3: Technology promotion through demonstration units

All costs are for the starting year (ie year 1) and for the subsequent years 4% inflation is considered

			Year 1	1	2	2	3	3	4	4	5	5	Tot budget for 5 yr
			Zone-1	Zone-2	Zone-1	Zone-2	Zone-1	Zone-2	Zone-1	Zone-2	Zone-1	Zone-2	
3.1		**Identification of appropriate technologies with regional focus**											
3 1 1		Assessment of technology needs/requirements											
	3.1 1 1	Survey and field interaction											
	3 1 1 2	Regional workshop	4200	4200	2184	2184							
3 1 2		Assessment of identified techology options											
	3 1 2.1	Literarture review/survey	2100	2100									
	3 1 2 2	Visits to brick industries/study tour (national/ international)											
	3 1 2 3	Evaluation of techno-commercial viability under local conditions	2100		6000	2200	17300	2300	7900	2300	6300	2400	
3.1.3		Selection of technologies	2100		6000	2200	17300	2300	7900	2300	6300	2400	
	3.1.3.1	Interaction with stakeholders (industry, associations, government, regulatory agencies, financial institutions											
			10500	6300	14184	6584	34600	4600	15800	4600	12600	4800	114568
3.2		**Detailed project reports (DPRs) for demonstration projects**	4200	2100	8736	6552	9085	6814	4724	2362			
3 2 1		Selection of entrepreneurs											
	3 2 1 1	Criteria for entrepreneur selection											
	3 2 1 2	Selection process for entrepreneurs											
	3 2 1 3	MoU with entrepreneurs											
3 2 2		Technology transfer tie-up	8400	4200	17472	13104	18171	13628	9449	4724			
	3 2 2 1	Negotiation with "technology providers"											
	3 2 2 2	ToR for technology provider/ technology transfer											
3 2 3		Financial tie-up for the project (with entrepreneur)											

			Year										
			1 Zone-1	1 Zone-2	2 Zone-1	2 Zone-2	3 Zone-1	3 Zone-2	4 Zone-1	4 Zone-2	5 Zone-1	5 Zone-2	Tot budget for 5 yr
	3 2 4	Preparation of DPR for individual demonstration units	10400	3500	23400	14400	24400	15000	11700	3900			
			23000	9800	49608	34056	51656	35442	25873	10987	0	0	240422
3.3	**Setting up demonstration units**												
	3 3 1	Energy efficient annular kilns (8 no)											
	3 3 1 1	Zone-1 (6 no)			97552		202908		211024		109733		621217
	3 3 1 2	Zone-2 - states of Bihar/Tamil Nadu/ Maharashtra (2 no)						101454		105512			206966
	3 3 2	Multi chamber kiln [4 no]											
	3 3 2 1	Zone-1 (NIL)											0
	3 3 2 2	Zone-2 - states of Bihar/ Tamil Nadu/ Maharashtra (4 no)				43368		45103		46907		48783	184161
	3 3 3	Use of alternate fuels (6 no)											
	3 3 3 1	Zone-1 (4 no)			32552		33854		35208		36617		138231
	3 3 3 2	Zone-2 - states of Bihar/ Tamil Nadu/ Maharashtra (2 no)						33854		35208			69062
	3 3 4	Use of internal fuel (fly ash) in bricks (2 no)											
	3 3 4 1	Zone-1 (2 no)					56351		58605				114957
	3 3 4 2	Zone-2 (NIL)											0
	3 3 5	Involvement of national/ international experts	20800		21632		22497		23397		24333		112660
			20800	0	151736	43368	315611	180411	328235	187627	170682	48783	1447254
3.4	**Monitoring and evaluation**				54600	29000	111800	87000	116200	90500	61400	32700	
	3 4 1	Technical evaluation of demonstration units (energy, environment, quality) (includes commercial viability)											
			0	0	54600	29000	111800	87000	116200	90500	61400	32700	583200

		Year 1 Zone-1	1 Zone-2	2 Zone-1	2 Zone-2	3 Zone-1	3 Zone-2	4 Zone-1	4 Zone-2	5 Zone-1	5 Zone-2	Tot budget for 5 yr
3.5	**Visit of potential entrepreneurs to demo units**							8436	8436	8774	8774	
								8436	8436	8774	8774	
3.6	**Development of regional technology packages**							11700	11700	12168	12168	
		0	0	0	0	0	0	11700	11700	12168	12168	**47736**

Year	Zone-1	Zone-2
Year-1	54300	16100
Year-2	270128	142008
Year-3	513667	307453
Year-4	506245	313850
Year-5	265624	107225
subtotal	1609965	886637
Budget for Immediate objective-3	2496601	

Annex 3.2

Letter of interests from financial institutions

भारतीय लघु उद्योग विकास बैंक
एस.सी.ओ. 145 - 146, सेक्टर 17 - सी, चण्डीगढ़ - 160 017

Small Industries Development Bank Of India
S.C.O 145-146, Sector-17-C, Chandigarh-160 017

/k /4(6B)

October 08, 2001

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13/10/2001

The Executive Director.
Punjab State Council for Science & Technology,
MGSIPA Building
Near Sacred Heart School,
Sector 26,
Chandigarh - 160 019

Dear Sir,

Improvement in Indian Brick Industry

Please refer to your letter dated 1.10.2001 on the above subject. We had also cussions in the matter with your officials who called on us a few days back. It transpired efrom that most of Brick Kiln units taking up demonstration Projects would require term ns of smaller size which would come under purview of our refinance assistance against loans nted to them by Banks/SFCs We may however, add that existing Brick Kiln Industry ng up expansion/modernisation programmes for energy savings and pollution control ich require loan in the region of Rs.40 lakh - Rs.50 lakh may be covered under our direct ncing subject to proposals satisfying various parameters of our Direct Finance Scheme.

Yours faithfully,

(D.K. Das)
Dy. General Manager

From: "Shanker Lal" <shanker@iredaltd.com>
To: <sjain@teri.res.in>
Date: 10/8/01 10 04am
Subject: Energy Efficiency Improvement in Brick Industry

Dear Mr Jain,

Please refer to your letter dated 26/09/2001 on above subject addressed to our Managing Director. We are pleased to inform you that IREDA is promoting and financing the energy efficiency improvement in industries However, for brick industry, who are mainly in SSI sector, direct lending by IREDA to these entrepreneurs many not be possible as the issues like size of loan (IREDA can not lend less that Rs.10 Lakhs), eligibility criteria (IREDA can lend to only limited companies/societies unless the security of Bank Guarantee is offered) and securitization of loan etc would have to be addressed. We would hence prefer involvement of an intermediary (TERI can also play this role), who would take the loan from IREDA and on-lend to brick units. We are attaching herewith an write-up on IREDA's energy efficiency operations for your kind reference. We would be pleased to provide any additional information, if so required by you.

Regards,

Shanker Lal,
Deputy Manager,
Energy Efficiency & Conservation(EEC)

Indian Renewable Energy
Development Agency Ltd. (IREDA)
Core-4 A, East Court, IHC Complex,
Lodhi Road, New Delhi - 110 003

Phone 4682214-21 Ext.227
Fax: 0091-11-4682204
Alternate E-mail. shanker_ireda@rediffmail.com

****
Originator: Indian Renewable Energy Development Agency Ltd
WebSite : http://www.ireda.nic.in
: http://www.iredaltd.com
****

Annex 4.1

Logical framework analysis

Logical framework analysis

Project strategy	Objectively verifiable indicators	Sources of verification	Critical assumptions and risks
Objectives:			
Global objective is to mitigate climate through reduction in CO_2 emissions from brick kilns in India	Quantified CO_2 emission reduction from Indian brick kilns	National greenhouse gases (GHG) inventories and reports to UNFCCC	Consistent with policies and priorities of the Government of India
Specific objective is to achieve energy-efficiency improvements in brick industries in India through capacity building, technology demonstration and creating access to financing.	• Identified project proponent • Better operating practices in brick kilns • Adoption of demonstrated technologies by the brick kilns	• Project status/progress reports • Financial Institutions (FIs)/ banks • Individual brick manufacturers (BMs) • Brick kiln associations • Reports of Coal India Limited and Ministry of Coal, which provide information of sectorwise coal supply	• Government of India's focus on upgradation and modernization of brick sector • Sustained interest of brick manufacturers
Outputs:			

Project strategy	Objectively verifiable indicators	Sources of verification	Critical assumptions and risks
Immediate objective 1: Establishment of an institutional mechanism for meeting the technological needs of Indian brick industry	• Institutional mechanism in place	• Government of India and concerned ministries • Project proponent	• Availability of infrastructure facilities • Demand by brick manufacturers/ brick associations
Output 1.1 Establishment of Project Management Office (PMO) – Setting up of PMO – Recruitments – Meetings	• PMO in place	• Project progress reports • Physical verification	• Availability of competent professionals • Non-interference by political leadership and bureaucracy
Output 1.2 Pre-feasibility reports for project activities – Preparation of prefeasibility reports – Presentation to various stakeholders	• Funding mechanism	• Project progress report	• Support of brick manufacturers and brick associations • Support from financial institutions, bilateral, government, etc
Output 1.3 Establishment of Technology Backup Unit (TBU)	• Faculty in place	• Project progress report • Physical verification	• Availability of faculty willing to work in brick sector

Project strategy	Objectively verifiable indicators	Sources of verification	Critical assumptions and risks
Output 1.4 Creation of pool of trainers – Training need assessment – Evolving specific training needs – Designing training packages	• Trained personnel for further providing training to brick kiln units	• Project Management Office	• Availability of faculty willing to work in brick sector • Support of brick manufacturers and brick associations
Output 1.5 Infrastructure facilities	• Infrastructure in place for: – Management – Faculty – Hardware – Testing facilities	• Project progress report • Physical verification	• Project proponent provides all necessary facilities • Cost escalation for infrastructure will not exceed the budget

Project strategy	Objectively verifiable indicators	Sources of verification	Critical assumptions and risks
Immediate objective 2: Capacity-building of the Indian brick industry through improved awareness and training	• Quantified reduction in CO_2 and energy savings • Trained manpower • Awareness level of brick manufacturers	• Comparison of fuel savings in brick kiln units before and after training programmes • Local/district/state level brick industry associations • Number of training programme carried out during the project duration • Trends of brick manufacturers participation in training programme • Project progress report • Report of Coal India Ltd/ Ministry of Coal	• Brick kiln units who take part in the training programmes utilize the acquired skill at the kilns, which will result in coal savings. • Capability of trainee/trainer to absorb/deliver the training. • Adequate awareness regarding training programmes • Better operating practices needs better supervision, the benefit of adopting better operation practices will get reduced if the workmen may not be following the guidelines as prescribed. • Brick manufacturer unwillingness to spare his workmen for training e.g perceived threat from workmen after getting the training in terms of high salary demands
Output 2.1 Promotion of training activities	• Awareness level among brick manufacturers • Brochures, newsletter, websites, journals, seminars, workshops, etc informing about training activities	• Brick manufacturers • Local/district/state level brick kiln associations • Project progress report	• Brick manufacturers realizing the benefits of training • Conflict of interests by brick manufacturers

Project strategy	Objectively verifiable indicators	Sources of verification	Critical assumptions and risks
Output 2.2 Network of experts/agencies/ institutes in the brick sector – Networking with international institutes – Networking with Indian experts	• Number and geographical coverage and distribution of experts/agencies/ institutes with whom networking has been established	• Progress report	• Existing and potential experts/agencies/ institutes working in brick sector
Output 2.3 Training needs assessment (TNA) – Visit to brick industries – Baseline study – Conducting TNA survey – Evolving specific training needs	• Results of assessment	• Report of training need assessment	▪ Brick manufacturers not providing adequate information about needs ▪ Project not able to collect relevant information
Output 2.4 Designing training programmes – Identification and selection of location – Selection of trainers – Designing regional training packages	• Availability of training modules for brick manufacturers • Availability of training modules for workers	• Evaluation by an independent expert • Training reports	• Adequate assessment of the needs for brick manufacturers and workers • Inputs from the network of experts/ agencies/ institutes • Capability of agencies to formulate training packages

Project strategy	Objectively verifiable indicators	Sources of verification	Critical assumptions and risks
Output 2.5 Implementation of training programmes - Training programme for brick manufacturers - Training programme for workmen	• Number of training programmes • Training calendar • Number of participants	• Brick kiln associations at local/district/state levels • Training/project progress report	• Availability of infrastructure • Enough awareness has been created among brick manufacturers for attending the training programs
Output 2.6 Monitoring and evaluation of training programs Identification of monitoring and evaluation agencies - Designing suitable monitoring system and formats - Report compilation	• Quantified CO_2 reduction and energy savings • Number of brick manufacturers attended the training programs and geographical coverage • Better working conditions at kiln site	• Evaluation by an independent expert • Feedback sheets from trainees • Project progress report	• Selection of appropriate monitoring and evaluation system

Project strategy	Objectively verifiable indicators	Sources of verification	Critical assumptions and risks
Immediate objective 3: Technology promotion through demonstration units	• Quantified reduction in CO_2 and energy savings • Initiatives by brick manufacturers and replication of demonstration units	• Local/district/state level brick industry associations • Local financial institution/ banks who are approached by a number of brick manufacturers for implementation of technologies • Project progress report	• Selection of appropriate technologies • Availability of technology providers • Availability of funds for the brick manufacturers through different financial institutions • Appropriate selection of brick manufacturers for demonstration projects • Technology transfer completed during project duration • Achieving claimed savings
Output 3.1 Identification of appropriate technologies with regional focus –Assessment of technology needs – Assessment of identified technology options – Selection of technologies	• Identified list of suitable technologies	▪ List of identified technologies ▪ List of identified technology providers ▪ Project feasibility report	▪ Availability of experienced technology providers in the region

Project strategy	Objectively verifiable indicators	Sources of verification	Critical assumptions and risks
Output 3.2 Detailed project reports (DPRs) for demonstration projects Selection of entrepreneurs Technology transfer tie-up Financial tie-up for the project Preparation of DPRs	• Tie-up with technology supplier • Tie-up with brick manufacturers	• Technology assessment report	• Availability and selection of technology providers, as per project requirements • Identification of brick manufacturers fulfilling the requirements for the demonstration projects • Availability of finance
Output 3.3 Setting up demonstration units Energy-efficient annular kilns Multi chamber kilns Use of alternative fuels Use of internal fuel (fly ash) in bricks	• Technology in place • Functioning of demonstration units as per prescribed guidelines	• Physical verification of demonstration unit • Project progress report • Local brick kiln owners • Local/district brick kiln associations • Reports of financial institutions/local banks	• Availability of loan from financial institutions/local banks to the brick manufacturer on time • Coordination between all stakeholders involved in setting up of demonstration unit • Willingness of the brick manufacturers to be involve in dissemination activities

Project strategy	**Objectively verifiable indicators**	**Sources of verification**	**Critical assumptions and risks**
Output 3.4 Monitoring and evaluation of demonstration projects – Technical evaluation of demonstration unit	• Quantified reduction in CO_2 • Reduction of coal consumption	• Feedback from demonstration units • Evaluation by an independent expert • Project progress report	• Technology transfer of demonstration units completed • Selection of appropriate monitoring and evaluation system
Output 3.5 Development of regional technology packages	▪ Replication of the technologies demonstrated for respective regions • Increased confidence of brick manufacturers for taking up demonstrated technologies	• Demonstration units • Technology providers • Local brick associations	▪ Technology transfer completed for the demonstrated technologies ▪ Inertia of brick manufacturers to switch over ▪ Continual support from financial institutions

Annex 4.2

Profile of project proponent

Annex 4.2

Profile of the project proponent

The project proponent is the Punjab State Council for Science & Technology (PSCST), Chandigarh. It is an autonomous registered body headed by Executive Director, Mr N S Tiwana, a noted environmentalist and ex-Chairman, Central Pollution Control Board. The Executive Director is assisted by Directors, qualified engineers and scientists. PSCST endeavours to harness the potential of science and technology as an instrument of socio-economic change and acts as a catalyst for transferring technologies from the laboratories to the field. In this process, it helps the development departments of the states to adopt new and advanced technologies in their respective fields. The policy of the council is to support R&D projects and programmes in the area of environmental protection. The Council also serves as focal point for planning, promoting and carrying out environment related activities/programmes besides evolving cost effective/innovative technologies in the field of environmental pollution caused by small scale industries. In addition, it also assists the Department of Science & Technology (DST), Government of India, Ministry of Environment & Forests, Government of India and central government agencies in all technical areas related to the environment protection and promotion.

The council has identified the following thrust areas:

1. Consultancy cell on industrial pollution control
2. Environment
3. Popularisation of science
4. Biotechnology
5. Construction and building material technology
6. Water regime management

Since 1997-98, the Council has achieved partial self-sufficiency through one of its important divisions the Consultancy Cell on industrial pollution control. This cell was set up in PSCST in 1991 for evolving cost effective pollution control technologies. It is manned by a group of dynamic environmental engineers with a vast experience in the field of pollution control. The projects undertaken so far reflect the latest cost-effective and the best available state-of-art technological options, which under no circumstances face the risk of failing the test of time.

The cell has successfully developed and demonstrated cost-effective technologies for pollution control in the following industrial sectors:

Air pollution control	*Water pollution control*
Brick kilns	Nickel-chrome plating units
Cupola furnaces	Zinc plating units
Rice shellers	Pickling units
Induction furnaces	Heat treatment units
Rolling mills	
Ceramic units	

While developing these technologies, the council mainly adopts the philosophy of: -

- Process modifications
- Cleaner production
- Waste minimisation
- Energy conservation

The council has replicated the various technologies in around 3000 units in the country. The consultancy cell also works closely with the National Productivity Council, Small Industries Development Bank of India (SIDBI), Department of Science & Technology and State Pollution Control Boards.

One of the major projects executed by engineers at the consultancy cell is energy conservation and air pollution control in brick kilns. The council was the first institute in India to demonstrate pollution control technology effectively in 1998 which has been replicated in around 2500 brick kilns in the country. Apart from pollution control technology, it also perfected and demonstrated improved feeding, firing and operating practices in brick kilns resulting in savings of 8-10% in coal consumption. Realizing the substantial savings, council with the active support of brick manufacturers, initiated the concept of onsite training programmes for brick kiln owners and their workforce.

Council engineers had undertaken visits to Italy and Germany to study the scope for mechanisation of brick kilns in India. The council in collaboration with Tata Energy Research Institute (TERI), had organized a conference on "Emerging trends in brick industry" so as to sensitize the brick sector on optimum usage of energy, benefits of mechanization and energy efficient technology. The conference had an overwhelming support attended by about 350 brick manufacturers, machinery suppliers and other relevant stakeholders.

Annex 4 3

Work plan

Annex 4.3

Work plan

S. No.	*Activity*	*Year*				
		1	*2*	*3*	*4*	*5*
1.0	**Institutional mechanism for implementation**					
1.1	Functional project management office (PMO)	▨				
1.2	Functional Technology Backup Unit (TBU)	▨				
1.3	Training of trainers (ToT)	▨				
1.4	Prefeasibility reports for project activities	▨	▨	▨	▨	
1.5	Infrastructure requirements	▨				
2.0	**Training needs**					
2.1	Promotion of training activities	▨	▨	▨	▨	▨
2.2	Network of experts/agencies/institutes in brick sector	▨				
2.3	Training needs assessment (TNA)	▨				
2.4	Designing training programmes	▨				
2.5	Implementation of training programmes		▨	▨	▨	▨
2.6	Monitoring and evaluation of training programmes		▨	▨	▨	▨
3.0	**Technology promotion through demonstration units**					
3.1	Identification of appropriate technologies with regional focus	▨	▨			
3.2	Detailed project reports (DPRs) for demonstration projects	▨	▨	▨	▨	
3.3	Setting up demonstration units		▨	▨	▨	▨
3.4	Monitoring and evaluation			▨	▨	▨
3.5	Development of regional technology packages			▨	▨	▨

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